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Pysico-Chemical and Biological Study of Mangho Pir Euthermal Springs Karachi, Sindh Pakistan

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Abstract: Water and biological samples were collected from 3 main points of Mangho Pir area(which is used regularly for commercial b athing by the visitors) and analyzed for physico – chemical and biological analysis. The temperatures remained constant 45-47.6 ^{0}C and are classified as Euthermal springs. The conductivity and pH were in the range of 2340 – 3460 μS/cm and 7.2 – 8.2 respectively. The Cyanophyta was dominant with 44 species, 8 species of Rhizopoda, 7 species of Chlorophyta, 6 species of Zooplankton, 4 species Bacillarophyta and 1 specie of Nematoda were present.

Key words: Limnological study, Mangho Pir hot springs

Introduction

Mangho Pir hot spring are located about 13 Km. north of Karachi at the base of Hallar mountainous range. These are indicated in the sheet No.35 P/11 Lat. 24.59' E. and 67.06' N. Longitude and are situated at an elevation of about 60 feet above sea level. The Mangho Pir springs were described by Baker and Maclagan (1844) as hot springs. Balfour (1967), Pithawala (1938), described that the springs have some curative effects for skin diseases.

Rafiquzzaman and Hassan (1964) have suggested that the curative effect of the water were due to the presence of arsenic in it. Zahid (1989) has reported some thermophilic algae at Mangho Pir spring. Similarly a number of natural springs have been reported from Pakistan and have been characterized by physico -chemical and biological study by Leghari *et al*, (1983, 1995, 2000) and Khuhawar *et al*, (1986). Present project examines the physico-chemical characteristics of the Mangho Pir spring water along with the biological life developed in the hot water sources.

Materials and Methods

Three samples were collected (I) open bath, (2) closed bath for men and women, (3) on south-east about 20-30m from spring 1 and 2 as open well type bath. The samples were collected in 1.5 L clean plastic bottles and each bottle was rinsed several times with sample water before collection. The water samples were collected on 28 November, 1999 and 21 May, 2000. The temperature of the water and air 1 m above the surface of the water, conductivity, salinity, and total dissolved solids were analyzed on the site. The samples for pH, chloride, hardness, alkalinity, phosphate, silicate, nitrate, Kjeldahl nitrogen, dissolved oxygen, sulphate, sodium, pot assium, calcium and magnesium were analyzed using standard procedures (A.P.H.A., 1980) next day.

The temperatures of water and air were measured with mercury thermometer. Conductivity, salinity and total dissolved solids were estimated with WTW LF 320 conductivity meter. pH was recorded with Orion 420A pH meter. Chloride, hardness and alkalinity were determined by titrimetry with standard silver nitrate, E.D.T.A and hydrochloric acid. Dissolved oxygen was estimated by Wrinker method. Phosphate, silicate and nitrate were determined by spectrophotometry using Hitachi 220 spectrophotometer. Nitrate was estimated using brucine sulphate as derivatising reagent. Silica was determined as molybdosilicic acid. Orthophosphate was estimated by the reduction of phosphomolybdate to molybdenum blue with ascorbic acid. Acid hydrolyzable phosphate-phosphorous was determined by persulphate digestion method, followed by estimation as the orthophosphate. Sulphate was determined by turbidiometric method using barium chloride. Chemical oxygen demand (COD) was determined by acid dichromate oxidation method using silver sulphate as catalyst.

Sodium, potassium, calcium and magnesium were determined by air-acetylene flame atomic absorption spectrometer at 589.0nm, 766.5 nm, 422.7 nm and 285.2 nm respectively using integration time 3 sec. and delay time 3 sec. at the conditions recommended by the manufacture.

Algal flora were collected by hand picking method with forceps from the side walls of the springs. The samples were cultured in petri dishes in soil medium at room temperature (25 °C). The Cyanophyta and Chlorophyta were identified after the reference. (Ward & Whipple,1959).

Results and Discussion

The water from the Mangho Pir springs seeps out as transparent, colorless and odorless. The water temperature observed between 45 to 47.6°C as compared to air temperature of 33 to 35°C. The springs may be classified as Euthermal (Vouck, 1950) and provided stable environment to ecosystems which may have remained unchanged (Brock., i967) .The results of chemical analysis are summarized in Table 1 and 2. The conductivity and TDS varied within 2.3 to 2.92 mS/cm and 1489-2213 mg/L respectively. pH was observed within 7.2 - 8.2. Chloride, alkalinity and hardness were observed within the range 425-570 mg/L as chloride, 290-375 mg/L as $CaCO_3$, 170-290 mg/L as $CaCO_3$ respectively. The dissolved oxygen was observed 4.2-4.5 mg/L. Sulphate was observed 200-224 mg/L. Nitrate-nitrogen, orthophosphate- phosphorous and total acid hydrolyzable phosphorous were observed in the ranges 0.2-0.4 mg/L, below the deduction, 0-0.04 mg/L respectively. Kjeldahl- nitrogen was observed 0-0.78 mg/L. The water samples did not contain organic compounds as impurities with the result that chemical oxygen demand (COD) was observed zero (0). The results of Na, K, Ca and Mg indicated following decreasing order.

Na > Ca ~ Mg > K

The concentration ranges were observed sodium 326-535 mg/L, calcium 32-90 mg/L, magnesium 27-75 mg/L and

Flora and Fauna of Mangho Pir Euthermal Springs Karachi

	40-42 °C	42-47.6 °C
Bacteria		
Beggiatoa alba (Vauch) Trevisan	++	+
Beggiatoa miníma Wing.	+	+
Thi Ploca sp.	+	++
Cyanophyta		
Aphanocapsa sp.	++	+
Aphanocapsa thermalis (Kutz) Brugg.	++	+
Aphanothece stagnina (Spr.) A. Br.	++	-
Chroococcus dispersus Lemm.	++	+
C. macrococcus (Kutz) Rab	++	+
C. minor (Kutz) Nag.	++	+
C. minutus (Kutz) Nag.	++	+
Cylindrospermun stagnale Kutz	+	-
Merismopedia thermalis Kutz	+	+
M. tenuissima Lemm.	+	+
M.glauca Nag.	+	+
Anabaena sp.	+	-
Nostoc cameum Ag	++	-
Oscillatoria amphigranulata Van Goor	+	+
Oscillatoria subtilissima Kutz	+	+
O.acuminata Gom	++	+
O.tenuis Ag	++	+
O.limosa Ag.	++	++
O.angusta, Kopper	+	-
Cylindrospermum stagnale (Kutz) Born et Flah	+	-
Pleurocapsa caldaria (Tilden) Setchal *	+	-
Pluto caldarious Tilden *	+++	-
Oscillatoria subtilissima Kutz.	+	+
O. okeni Ag	+	++
O. amoena Gom	+	+
O. chalybea (Mert) Gom	+	-
O. terebriformis Ag	+	+
Phormidium molle (Kutz) Grun.	+	+
P. laminosum Gom.	+	+
P. tenue (Meneg) Gom.	+	+
P.subcapitatum B.Petersen	+	+
P.frigidum Fritsch	++	+
Synechocystis salina Wisl.	+	+
Synechococcus cedyorum Sauv	+	+
S.aeruginosus Nag	+	-
Spirulina laxa G.M. Smith	+	+
S. labyrinthiformis (Menegh) Gom.	+	+
S. subtilissima Kutz.	+	+
Lyngbya hieronymusii Lemm	+	+
Chlorophyta		
*Chlorella vulgaris** Beyerinck	+	-
Chlorococcum humicola (Nag) Rab.*	+	-
Kirchneriella contorta Bohlin*	+	-
*Scenedesmus quadricauda** (Trup.,) Breb.	+	-
S.arcuatus Lemm	+	-
*S. quadricauda var. longispina** (Chod)Smith.	+	-
S. bijugatus (Turp) Kutz*.	+	-
Bacillarophyta		
Cymbella turgiduia (Greg) Cl*	+	+
Cymbella ventricosa Kutz*	+	-
Navicula viridula Kutz*	+	-
Navicula cf. simi lis Hust.*	+	-
Spermatophyta		
Typha domingensis *	+	-
Protozoa		
Amoeba sp.*	+	-
Lecane sp.*	+	-
Spelaeo necta sp.*	+	-
Conochilus cf. hippocrepis Sch.*	+	-
Nematoda sp.*	+	-
Lepadella Sp.*	+	-
Rhizopoda		
Thecamoba cf. verrucosa Eh.*	+	+
Pelomyxa sp.*	+	-
Astramobea cf. radiosa Ehr.*	+	-
Tubulina sp.*	+	+
Mayorella sp.*	+	-
Arcella sp.*	+	+
Amoeba sp.*	+	-

- Absent, + Present, ++Abundant, +++ Dominant, * First report.

Table 1: Water Analysis Samples Are Collected from Mangho Pir Springs. Dated on 28-11-99

Parameters	1	2	3
Temperature of water(°C)	45	47.4	47.6
Temperature of air(° C)	29.5	30	29
Color	Transparent	Transparent	Transparent
PH	8.20	8.16	7.5
Conductivity (μS/cm)	2920	2980	3460
Salinity (g/L)	1.1	1.1	1.6
TDS in mg/L	1868	1907	2213
Chloride (mg/L)	425	496	570
P-Alkalinity as $CaCO_3$ (mg/L)	0	0	0
M- Alkalinity as $CaCO_3$ (mg/L)	300	350	375
Hardness as CaCO3 (mg/L)	170	170	250
Sulphate (mg/L)	224	222	112
Kjeldahl's Nitrogen (mg/L)	0.26	0.45	0.78
Ammonia-Nitrogen (mg/L)	0	0.22	0
Nitrate (mg/L)	0.2	0.4	0.3
Silica (μg/L)	11.5	10.5	11.5
Sodium (mg/L)	375	410	535
Potassium (mg/L)	13	18	25
Calcium (mg/L)	37	40	90
Magnesium (mg/L)	27	34	60

Sampling stations

1: Hot Spring Mangho Pir inside compound walls . Length 40, width 5. and Depth 5, feet. 2: Hot Spring Mangho Pir open on road. Length 2, width 3. and Depth 4, feet. 3: Mangho Pir Spring. South- East about 20-30 m from spring 1 & 2

Table 2: Water Analysis Samples Collected from Mangho Pir Springs Dated on 21-5-2000

Parameters	1	2
Temperature of water (°C)	45	47
Temperature of air (°C)	34	34
Color	Transparent	Transparent
PH	7.27	7.33
Conductivity (μS/cm)	2340	2360
Salinity (g/L)	1.2	1.2
TDS (mg/L)	1498	1510
Total residue on 105°C (mg/L)	1100	1120
Fixed residue (mg/L)	410	260
Volatile residue on 550°C (mg/L)	690	860
Chloride (mg/L)	450	486
P-Alkalinity as $CaCO_3$ (mg/L)	0	0
M- Alkalinity as $CaCO_3$ (mg/L)	290	345
Hardness as CaCO3 (mg/L)	280	290
Acid Hydrolyzable phosphate (mg/L)	0.04	0.04
Sulphate (mg/L)	208	200
Kjeldahl's Nitrogen (mg/L)	0	0
Chemical Oxygen Demand (mg/L)	0	0
Dissolved oxygen (mg/L)	4.4	4.5
Sodium (mg/L)	326	336
Potassium (mg/L)	13	15
Calcium (mg/L)	32	38
Magnesium (mg/L)	30	38

Sampling Stations

1 Hot Spring Mangho Pir inside compound walls. Length 40, width 5. and Depth 5, feet.

2 Hot Spring Mangho Pir open on road. Length 2, width 3. and Depth 4, feet.

Fig. 1-41: Mangho Pir Euthermal spring Karachi
1. *Chroococcus turgidus var. maximus.*
2. *Chroococcus turgidus.*
3. *Chroococcus minutus* (Kutz) Nag
4. *Chroococcus lithophilus* Erh.
5. *Chroococcus cf Pallidus* Nag.
6. *Aphanothece stagnina et Geitler.*
7. *Aphanothece* sp.
8. *Pluto caldarius* Tilden.
9. *Pleurocapsa calderia* (Tilden) Setchel.
10-11. *Chroococcus minima* Kutz.
12. *Beggiatoa minima* Wing.
13. *Oscillatoria terebriformis* Ag.
14. *Phormidium subcapitatum* Peterson.
15. *Oscillatoria tenuis* Rao.
16. *Oscillatoria okeni* Ag.
17. *Phormidum molle* (Kutz) Gom.
18 & 20. *Nostoc carneum* Ag.
19. Unknovvn fungul spores.
20. *Nostoc carnum* Ag.
21. *Cylindrospermum stagnale* (Kutz) Bornet et Falah.
22. *Lyngbya hieronymusii* Lemm.
23. *Oscillatoria limosa* Ag.
24. *Arcella* sp
25. *Chlorococcum humicola* (Nag) Rab.
26. *Chlorella vulgaris* Bej.
27. *Scenedesmus arcuatus* Lemm.
28. *Vovlcina* sp
29. *Scenedesmus bijugatus* (Trap) Kutz.
30. *Trachelomonas volvocina* Ehren.
31. *Cymbella turgiduia.*
32. *Diatomella* sp.
33. *Navicula thermicola.*
34. *Naviula dicephala.*
35. *Navicula incerta.*
36. *Pleurosigma cf elongatum* W.Sm.
37. *Astramobea cf. A. radiosa* Ehre.
38. *Amoeba* sp?
39. *Thecamobea cf. verrucosa* Ehre.
40. *Lapedella* sp
41. *Astramobea cf. A. radiosa* Ehre.

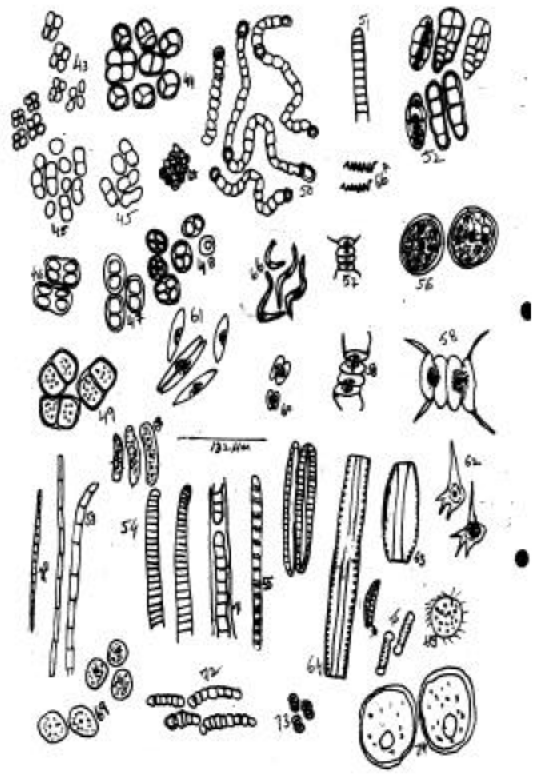

Fig. 42-74: Mangho Pir Euthermal spring Karachi
42.43. *Chorococcus disprusus* Lemm.
44. *Pluto caldarious* Tilden
45. *Aphanothece stagnina* Geitler.
46.47. *Chroococcus turgidus* (Kutz) Nag.
48. *Chroococcus minor.*
49. *Chroococcus turgidius var maximus* Nygar
50. *Nostoc carneum* Ag.
51. *Oscillatoria tenuis* Ag.
52. Unknovvn Fungal spores.
53. *Oscillatoria acuminata* Gom.
54. *Oscillatoria curviceps* f.Rao.
55. *Phormidium laminosum* (Ag.) Gom.
56. *Chlorococcum humicola* (Naeg) Rab.
57.58. *Scenedesmus quadris* Chodat.
59. *Scenedesmus quadricuda.*
60. *Scenedesmus bijuga* (Turp.) Lag.
61. *Quadrigula* sp
62. *Astramoeba cf radiosa* Ehre.
63. *Fragilaria* sp.
64. *Fragilaria* sp
65. *Spelaeonecta* sp.
66. *Kirchneriella contorta* Bohlin.
66. A. *Spirulina subtilissima* Kutz.
67. *Dactylococcopsis planctonica* Tailing.
68. *Dactylococcopsis smithii* R.et.Chod.
69. *Synechococcus cf. gaarderi* Alv.
70. *Phormidium tenue* (Meneg) Gom.
71. *Phormidium tenue* (Meneg) Gom.
72. *Anabena* sp.
73. *Synechococcus cedrorum* Sauv.
74. *Arcella* sp

potassium 13-25 mg/L. similar concentration of salts were observed from Zai and Pokhan springs from Thana Bola Khan area. (Leghari *et al.*, 1995).

On the surface of the wet soil and stones above the water surface following species were found present. *Chlorella* vulgaris, *Chlorococcum* humicola, *Kirchneriella* contorta, *Scenedesmus* quadricauda, *Scenedesmus* arcuatus, *Scenedesmus* bijugatus, *Trachelomonas acnthostoma*, belongs to Chlorophyta. *Oscillatoria* acuminata, *Phormidium* laminosum Gom, *Phormidium* sp., *Nostoc* carneum Ag, *Pluto* caldarius, *Gloeocapsa* calcarea, *Chroococcus* disperses of Cyanophyta and some species of *Navicula sp of* Bacillarophyta were identified.

In the spring water with temperature 45-47.6°C, the Cyanophytes forming bluish layer on the surface of water along with the leaves of the *Prosopis glandulosa. Aphanocapsa thermalis* (Kutz) Brug. *Chroococcus minor* Ag. *Chroococcus disperses*, *Chroococus tenax, Merismopedia thermalis, Marismopedia* sp. *Synechocystis salina, Lyngbya martensiana. Lyngbya major, Oscillatoria subbrevis, O. angustissima, O. limosa, O. terebriformis, Spirulina labyrinthiformis, Cymbella sp. Navicula cf. thermicola, Navicula incerta* and *pleurosigma elongatum* belonging to Bacillarophyta along with some spices of *spermatophyta,protoza* and *Rhizopoda* were also found present. The physico – chemical characteristics attributes in the presence members of the cyanophyta (Table 3) in the Mangho Pir hot springs shows close resemblance with the work of Vashishta (1968), Thomas and Gonzalves (1965) Jha and Kumar (1990) from the thermal springs of India.

The used water stored on the back side of the bathing places in depressions, was full with *Typha domingensis* growing along with bluish black layer by the *Phormidium* sp, *Oscillatoria* sp., *Spirulina labyrinthiformis* and some bacteria , *Beggiatoa minima,B.alba* with some species of Bacillarophyta and Nematoda.

The observed chemical analysis results are in agreement as reported by Beg *et al.* (1984) and examines the concentration of nutrients and major metal contents in the water. The algal flora reported in present work also support the result of Zahid (1989). However the present work confirms and reports some additional species of Algae, Spermatophyta, Bacteria , Protoza and Rhizopoda observed in the water.

The temperature of the spring water has remained constant for over 1½ century.

The water contained sodium chloride and calcium carbonate as the main salts. In hot spring waters Cyanophyta species were dominant.

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