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Physicochemical study of drinking water of talukaMirwah and KotDiji from District Khairpur Mir's

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Abstract: A comprehensive picture of quality of water of 24 different location of talukaMirwah and Kotdiji of district Khairpur Mir's of Sindh Pakistan is presented in this paper. Samples from hand pumps were collected and investigated for both physical and chemical parameters pH, EC, TDS, hardness, alkalinity, Chlorine, sulfate, nitrate, nitrite Na, Ca, K, Mg, Fe, Cu, Cd, and Zn, for quality investigation. These parameters limits were compared with the permissible limits recommended by W.H.O some parameters were obtained within the allowable levels but most have objectionable limits. Water samples of Mirwah and Kotdiji showed very high level of conductance 3480µS/cm TDS 2227mg/L higher than recommended by World Health Organization. All the water samples were different in copper and zinc. Some of the water samples are suitable for drinking purposes but many have objectionable levels of certain parameters. Therefore the water from Mirwah and Kotdiji are unsuitable for human consumption.

Keywords: Groundwater, contamination, chlorides, TDS, EDTA.

1. INTRODUCTION

The importance of fresh water for human health has no doubt, groundwater has been used in the district Khairpur Mir's as a source of drinking water for centuries. District Khairpur Mir's is located in Sindh. It was found in 1783 in1832 recognized by British and in 1956 acceded to Pakistan. It is about 60 meters above the sea level with an area of 15736 square kilometers district lies between latitude 26-0-27-45 and longitude 68.070.15 .district Khairpur Mir's comprises eight talukas namely, Sobhodero, Kingri, Khairpur, Mirwah, FaizGanj, Nara, Kotdiji and Gambat. According to 1998 census, population of Khairpur Mir's 15,46,059 the rural of population district is 11, 81, 037 constituting 76.39% of the total population, urban population in 3, 65, 022 which constitutes 23.61%. The source of drinking water in district Khairpur is ground water.. The soil of the district is sandy with hard clay loams with a negligible exception where the soil is saline. Improperly designed rural sanitary facilities also contribute to contamination of ground water. Regarding physico-chemical characteristics of ground water of the district no any work has been reported. Hence this research work aims to assess the quality of drinking water regarding its physico-chemical characteristic.

2. MATERIALS AND METHODS

The groundwater samples are collected from the twenty four located villages and towns of the study area. . Study area locations are given in table 5 , Parameters like total hardness, nitrates, nitrites, pH, magnesium hardness, calcium hardness, total alkalinity, EC, TDS, chlorides and sulphates were analyzed by applying the standard methods.

Water samples of ground water were collected from twenty four various places of talukaMirwah and Kotdiji of the district in clean polyethylene bottles to ascertain the physico-chemical parameters. Using mercury thermometer temperature of water and air 1 meter above the surface of water was noted. Orion 115 conductivity meter was used to measure the conductivity and total dissolved solids. pH meter Orion 420 A was used to record the pH. Hardness, chloride and alkalinity were analyzed by titration with standard EDTA, $AgNO_3$ and HCl. Derivatized with brucine sulfate, nitrate was analyzed. By derrivatization with N-naphthyl ethylene-diamine Nitrite was investigated.

Sulfate was estimated using turbimetry as $BaSO_4$ by double beam spectrophotometer 220 of Hitachi Company.

Atomic absorption spectrometer (Varian specter AA-20) with standard burner head and air acetylene flame was used to investigate the metal ions sodium, potassium, calcium ,magnesium, iron, copper, zinc and cadmium. Procedure for estimation was performed in triplicate with integration time 3 seconds and delay time 3 seconds. Na, K, Ca, and Mg after proper dilution were investigated. Component (250ml) contain HNO_3 (1ml) was heated gently was at 90-95^{0}C, concentrated up to 15-20 ml. and the finally adjusted volume up to 25ml. Components of Fe, Cu, Zn, and Cd from the solution

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was investigated by air acetylene flame atomic absorption as manufacturer recommended.

3. RESULTS AND DISCUSSIONS

Table-5 indicate the locations of twenty four drinking water samples collected from ground water of talukaMirwah and Kotdiji of the district.

This studied to investigate the limits of both physical and chemical parameters like conductivity, TDS, salinity, chlorides nitrate, metals and the results obtained have been presented in table's 1-4.

The results of physicochemical analysis are given in table 1& 3. PH of all samples was found with in the WHO permissible limit for drinking water. The pH of all the ground water in the study area was found 6.4 to 8.4. The electrical conductivity (EC) of all water samples was above the WHO guide line for drinking water. The (EC) of water samples ranged from 1107-2900µs /Cm, and TDS was varied from 709-1856 mg/L. The salinity was fluctuated at 0.5-1.5 mg/L. Hardness of our investigated water samples were found in WHO standard range e.g. 500mg/L and varied from 210-315 mg/L. Alkalinity of all samples varied from 210-340 mg/L. Electric conductivity and total dissolved solids values varied within the ranges 1107to 2920µS/cm and 709- 2445 mg/ L.

Singh *et al ;*(2012) evaluated ground water quality in northern Indo-Gangetic Alluvium Region, India and found that ground water samples showed levels of TDS, hardness, alkalinity, Cl, F, SO_4, Ca, Mn, Pb, Cr and Fe above their respective permissible limits . Alvi *et al;* (2006) investigated the contamination of ground water from trace metals in site area of Karachi, Pakistan, It showed that the level of pb ,Cu,Cr and Ni are not in detectable limit while one sample showed high(38 ppb).

In the study area total alkalinity values are within the allowable levels the alkalinity of TalukaMirwahavaried from 268-335 mg/l whereas alkalinity of TalukaKotDiji was found 216-368 mg/l ,we also observed that the alkalinity of water in certain locations was high this may be due to the salts and bicarbonate concentration. Rauf*et al ;(*2002) carried out water analysis of Rawal Lake and its surrounding areas, Rawalpindi, and found that alkalinity, hardness, BOD, COD, DO, Cl, nitrate, phosphate and sulphate were within permissible limits of WHO, except, nitrate of one sample (13 mg/L). Gagneten *et al.,* (2007) studied heavy metal pollution and Eutroplication in the lower Salado River Basin, Argentinea. In the study, levels of heavy metals (Cr, Cu, Pb and Cd) in water and sediments of the lower Salado River (Argentinea) were presented and compared to Canadian and Argentinean standards. There were differences between the accumulation of metals in sediments and water and the control sampling site. Heavy metals especially, Cr, Cu and Pb, appeared to be an important problem to these fresh water environments.

Chlorides: The chlorides of ground water of TalukaMirwah indicated the variation within 146 to 371 mg/L. While the level of chloride in TalukaKotDiji in range between 136 to 381 mg/L. In all types of rocks chloride is a widely distributed element in one or the other form. Hence, in ground water it shows high concentration. Level of electrolyte balancing in blood plasma chloride plays an important role, but some physical disorders can be produced by its higher concentration. Chloride may cause gastrointestinal problems, irritation and dehydration due to its high levels in ground water.

Taylor *et al* ;(2006) studied that the mixing of water from different sources effect on quality off water. The conventionally treated ground water (G1), surface water processed by enhanced treatment (S1) and desalted sea water (RO) were analyzed. G1 water had high alkalinity, while, S1 and RO water sources were found to have high sulfate and chloride respectively.

Sulfates: In natural water sulphate ion has great importance for human being when it exceed from 150mg/l, it may cause dehydration, catharsis, GIT irritation. The concentration of sulfates varied within 190 to 402 mg/L, while the water samples having code No 13 village Maroro exceeded the limit of WHO. High concentration of sulfate imparts bad taste and when combined with Na or Mg becomes laxative and causes cathartic effects and corrosive mode of act. Wu *et al* (2005) reported source identification of ground water pollution with the aid of multivariate statistical analysis in Taiwan. The water samples were analyzed for pH, EC, hardness, chloride, sulfate, ammonia, nitrate, iron, Fe, Mn, As, Zn and TOC. These parameters were subjected to factor and cluster analysis.

Bicarbonates and Hardness: The basic sources of hardness in water are cations like as Ca and Mg and the major anions which cause the water hard such as chloride, bicarbonate, carbonate, and sulphate. Although no known adverse effects are even by water hardness; But certain evidence reveals that the hardness of water may play a role in heart diseases.it is also reported that, if hardness of water reached above 100-330 mg/l may cause the formation of stone in kidney (kidney stone) and other problems relate to the kidney. The bicarbonates of water samples showed concentration within 162 to342 mg/L.

Nitrite and Nitrate: According to obtained results in all the regions of groundwater sources nitrite concentration is low. Nitrites, nitrates and organic nitrogen are often known forms of nitrogen. Nitrates may attain high limits in groundwater but in surface water it may occur in trace quantities. Presence of nitrogenous fertilizers in the water body is due to decomposition of proteinous components in waste water. Allowable level of WHO guidelines for nitrite is 1.0 mg/L and it is more toxic. The highest allowable level of nitrate concentration in potable water is 10 mg/L according to WHO guidelines. Nitrite and nitrate values of all samples are within the limits i.e 0.02 - 0.158 mg/L and are found within the limits.

Cation Chemistry: Calcium is alkaline in nature and essential element for development of proper bone growth. Presence of calcium in ground water may be from amphibole in igneous rocks, from silicate minerals (pyrxene).

Calcium limits in drinking water recommended by WHO is75mg/L.Major metal contents (Na, K, Mg and Ca) concentration varies with in the samples and Na was dominant observed throughout as Na>Ca>K>Mg varied as Na 74-265 mg/L, Ca 71-218 mg/L, K 13-66 mg/L and Mg 36-135 mg/L. Major metal ion concentration of samples 23, 34 and 43 indicated higher concentration of major metal ion may because of high deposit of salts there.

The minor metal ion were found with the variation of Fe 0.02- 0.505 mg/L, Zn 0.017- 0.036 mg/L, Cu 0.002- 0.02 mg/L, Pb 0.026 - 0.39 and Cd 0.003- 0.022 mg/L. Khan *et al*., (2008) evaluated quality characteristics of the urban areas of Peshawar, and the results were compared with WHO potable water quality standards. The said study revealed that an increasing trend in Mg contents than Ca. Mg in sample no 18 was higher than Ca compared to the previous study. Asghar *et al*., (2006) studied the pattern of water supply in Mirpurkhas and Larkana, and found that the Concentration of As was below the permissible limit, While the concentration of water of Larkana was found many variation (0.40-20.02 ppb), it was also reported that the water sample of Larkana showed 10% exceeded the WHO limit.

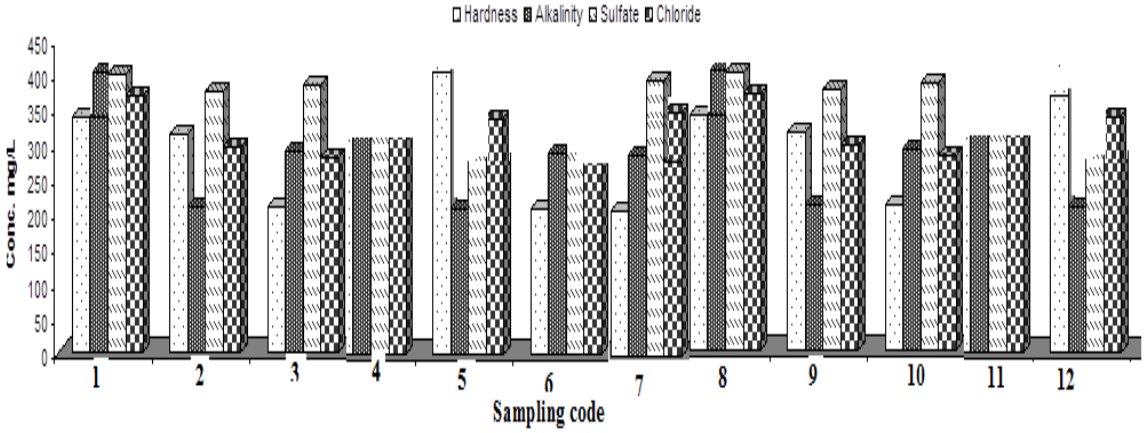


Fig.1 :Hardness, alkalinity, sulphate and chloride contents of water samples.

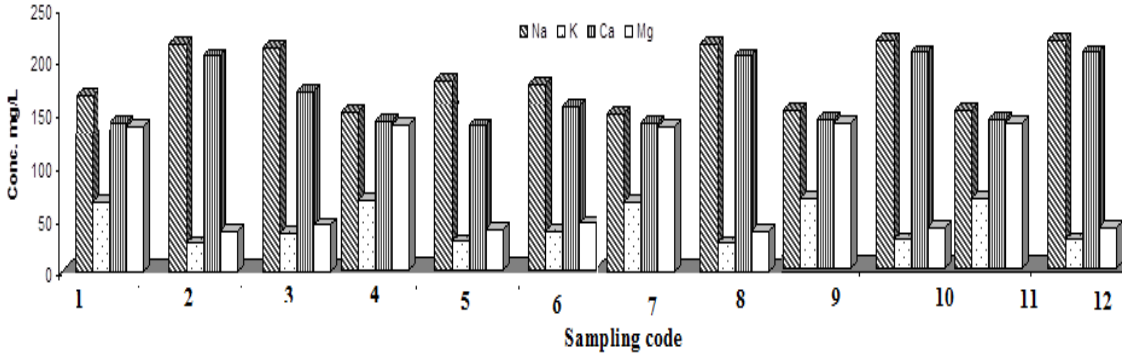


Fig. 2: Metal ions (Na, K, Ca, and Mg) contents of water samples of study area

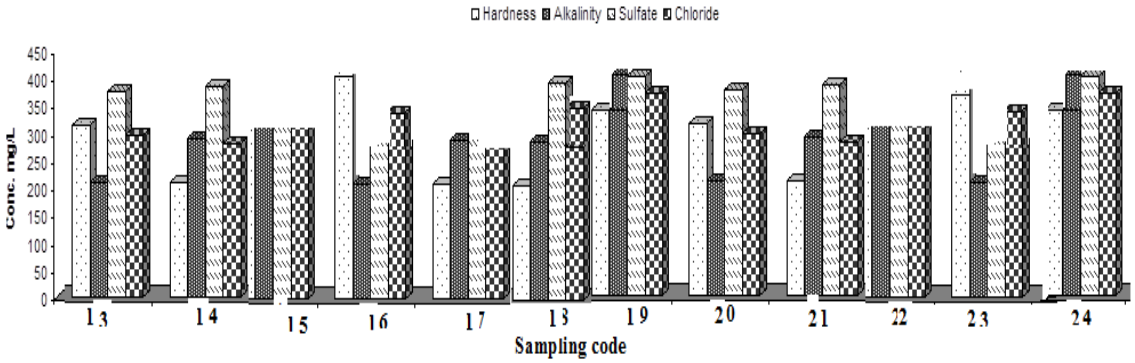


Fig. 3: Hardness, alkalinity, sulphate and chloride contents of water samples.

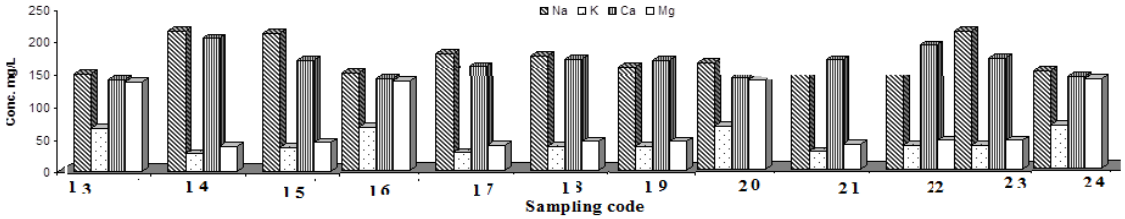


Fig.: 4: Metal ions (Na, K, Ca, and Mg) contents of water samples of study area

Table:1: Physico - Chemical Parameters of water samples of study areaTalukaMirwah.

Parameter	1	2	3	4	5	6	7	8	9	10	11	12
Ph	7.56	6.9	6.4	7.2	7.7	7.9	6.7	7.6	8.4	7.1	7.4	7.4
Conductivity µS/cm	2900	1909	1107	1218	1484	1476	1831	1004	3420	1643	2090	1216
TDS mg/L	1856	1222	709	780	950	945	1172	643	2445	1051	1337	779
Salinity mg/L	1.5	1.0	0.5	0.6	0.7	0.7	0.9	0.5	1.2	0.9	1.0	0.6
CaCO3 mg/L	340 (4.1)	315(4.3)	210(4 .6)	280 (4.5)	295 (4.4)	290 (4.5)	315 (4.3)	168 (4.8)	318 (4.3)	192 (4.7)	192 (4.7)	172 (4.7)
Nitrite-N mg/L	0.02 (4.8)	0.04 (4.6)	0.122 (4.3)	0.025(4.8)	0.178 (4.5)	0.151 (4.6)	0.03 (4.7)	0.875 (4.2)	0.825 (4.6)	0.375 (4.2)	0.5 (4.5)	0.132 (4.9)
Sulfate mg/L	392 (3.7)	376 (3.9)	386 (3.8)	278 (4.3)	280 (4.3)	190 (4.6)	298 (4.2)	260 (4.3)	258 (3.9)	272 (3.5)	248 (4.9)	241 (3.9)
Chloride mg/L	371 (4.2)	295(4.4)	280 (4.4)	202 (4.5)	185 (4.6)	218 (4.4)	247 (4.3)	186 (4.6)	282 (4.4)	286 (4.2)	246 (4.6)	146 (4.8)
Alkalinity-M mg/L	340 (3.9)	210(4.3)	290 (4.1)	270 (4.7)	350 (4.5)	208 (4.4)	335 (4.5)	290 (4.6)	339 (4.2)	368 (4.3)	298 (4.5)	268 (4.3)

Table:2:Essential metal ions (Na, K, Ca, and Mg) concentration of water samples TalukaMirwah

Parameters	1	2	3	4	5	6	7	8	9	10	11	12
Na mg/L	149 (4.5)	215 (4.3)	212 (4.3)	265 (3.8)	79(4.6)	220 (4.1)	138 (4.3)	221 (3.9)	129 (4.4)	218 (4.1)	250 (3.5)	79 (4.5)
K mg/L	66 (3.9)	27(4.4)	36 (4.2)	14 (4.5)	15 (4.5)	21 (4.4)	23 (4.4)	22 (4.5)	24 (4.3)	15 (4.5)	18 (4.6)	23(4.4)
Ca mg/L	141 (4.6)	204 (4.2)	170 (4.4)	212 (4.3)	67 (4.8)	71 (4.7)	95 (4.5)	86 (4.6)	120 (4.4)	103 (4.5)	71 (4.7)	124 (4.4)
Mg mg/L	137 (4.2)	38(4.7)	44 (4.6)	59 (4.2)	78 (4.4)	58 (4.2)	53 (4.5)	51 (5.2)	48 (4.4)	42 (4.4)	47 (4.4)	40 (4.5)
Fe mg/L	0.45 (4.1)	0.278 (4.6)	0.376 (4.3)	0.042 (4.5)	0.042 (3.5)	0.032 (4.5)	0.02 (4.7)	0.04 (4.4)	0.505 (3.8)	0.505 (3.8)	0.30 (3.8)	0.042 (4.5)
Zn mg/L	0.03 (4.7)	0.036 (4.7)	0.018 (4.9)	0.204 (3.7)	0.274 (3.4)	0.022 (4.6)	0.042 (4.4)	0.105 (4.3)	0.012 (4.6)	0.017 (4.1)	0.02 (4.6)	0.04 (4.4)
Cu mg/L	0.02 (4.3)	BDL	0.002 (5.1)	0.009 (4.8)	0.009 (4.8)	0.044 (4.4)	0.017 (4.7)	0.007 (4.9)	0.019 (4.7)	0.009 (4.8)	0.02 (4.7)	0.009 (4.8)
Cd mg/L	0.005 (5.2)	0.022 (4.6)	0.009 (4.9)	0.004 (5.3)	0.005 (4.1)	0.004 (5.1)	0.004 (5.1)	0.004 (4.1)	0.003 (5.2)	0.004 (5.1)	0.004 (5.1)	0.004 (4.1)
Pb mg/L	0.09 (4.6)	0.067 (4.8)	0.39 (4.1)	0.054 (4.2)	0.092 (4.1)	0.026 (4.2)	0.046 (4.6)	0.032 (4.5)	0.053 (4.2)	0.041 (4.6)	0.046 (4.2)	0.041 (4.3)

Table: 3: Physico - chemical parameters of water samples of study areaTalukaKotDiji.

Parameter	13	14	15	16	17	18	19	20	21	22	23	24
pH	7.9	6.8	7.5	7.2	7.7	7.9	6.7	7.6	7.8	7.1	7.4	7.4
Conductivity µS/cm	2920	1930	1117	1218	1494	1476	1831	1014	3402	1643	2095	1228
TDS mg/L	1859	1227	712	780	952	945	1172	644	2442	1051	1338	782
Salinity mg/L	1.5	1.0	0.5	0.6	0.7	0.7	0.9	0.5	1.2	0.9	1.0	0.6
CaCO3 mg/L	342(4.1)	325(4.3)	220(4.6)	270(4.5)	275(4.4)	292(4.5)	318(4.3)	188(4.8)	328(4.3)	172(4.7)	182(4.7)	162(4.7)
Nitrite-N mg/L	0.044(4.8)	0.031(4.6)	0.112(4.3)	0.028(4.8)	0.158(4.5)	0.141(4.6)	0.02(4.7)	0.875(4.2)	0.625(4.6)	0.475(4.2)	0.545(4.5)	0.132(4.9)
Sulfate mg/L	402(3.7)	376(3.9)	376(3.8)	288(4.3)	282(4.3)	198(4.6)	291(4.2)	257(4.3)	241(3.9)	268(3.5)	248(4.9)	256(3.9)
Chloride mg/L	381(4.2)	292(4.4)	284(4.4)	202(4.5)	175(4.6)	218(4.4)	246 (4.3)	181(4.6)	282(4.4)	281(4.2)	256(4.6)	136(4.8)
Alkalinity-M mg/L	342(3.9)	216(4.3)	292(4.1)	280(4.7)	340(4.5)	248(4.4)	325 (4.5)	295(4.6)	319(4.2)	368(4.3)	248(4.5)	248(4.3)

Table:4:Essential metal ions (Na, K, Ca, and Mg) concentration of water samples (TalukaKotDiji)

Parameters	13	14	15	16	17	18	19	20	21	122	23	24
Na mg/L	153(4.5)	205(4.3)	212(4.3)	260(3.8)	79(4.6)	210(4.1)	128(4.3)	225(3.9)	137(4.4)	214(4.1)	252(3.7)	74(4.5)
K mg/L	62(3.9)	27(4.4)	31(4.2)	14(4.5)	13(4.5)	22(4.4)	23(4.4)	26(4.5)	24(4.3)	19(4.5)	28(4.6)	26(4.4)
Ca mg/L	151(4.6)	214(4.2)	174(4.4)	218(4.3)	73(4.8)	71(4.7)	91(4.5)	82(4.6)	125(4.4)	102(4.5)	76(4.7)	134(4.4)
Mg mg/L	137(4.2)	36(4.1)	44(4.6)	54(4.2)	71(4.4)	55(4.2)	57(4.5)	61(4.2)	38(4.4)	45(4.4)	55(4.4)	50(4.5)
Fe mg/L	0.45(4.1)	0.228(4.6)	0.366(4.3)	0.042(4.5)	0.042(4.5)	0.052(4.5)	0.06(4.7)	0.04(4.4)	0.515(3.8)	0.505(3.8)	0.307(3.5)	0.042(4.7)
Zn mg/L	0.035(4.7)	0.031(4.1)	0.028(4.7)	0.204(3.7)	0.264(3.8)	0.032(4.2)	0.042(4.4)	0.115(5.1)	0.017(4.6)	0.027(4.8)	0.017(3.6)	0.03(4.4)
Cu mg/L	0.02(4.3)	BDL	0.002(5.1)	0.007(4.5)	0.003(4.8)	0.024(4.1)	0.017(4.7)	0.007(4.9)	0.019(4.7)	0.009(4.8)	0.004(4.3)	0.009(4.8)
Cd mg/L	0.005(5.2)	0.021(4.6)	0.008(3.9)	0.005(5.3)	0.003(5.1)	0.004(5.1)	0.004(5.1)	0.003(4.1)	0.003(5.2)	0.004(5.1)	0.004(5.1)	0.004(4.1)
Pb mg/L	0.09(4.6)	0.057(4.8)	0.35(4.6)	0.044(4.2)	0.092(4.1)	0.026(4.2)	0.042(4.2)	0.036(4.8)	0.051(4.2)	0.045(4.6)	0.043(4.3)	0.044(4.6)

Table 5- Code numbers of ground water samples collected from different locations of talukaMirwah and Kotdiji of district Khairpur Mir's Sindh, Pakistan.

Water samples locations	Sample Code No.
G.W.H.P ZaraiTarqiati Bank of Pakistan KotBanglow	1
G.W.H.P of Rahim BuxJanwariKotBanglow	2
G.W.H.P of Haji Atta Mohammad CandioKotBanglow	3
G.W.H.P at Village Khair Mohammad Khaskheli	4
G.W.H.P of Wahid BuxSolangi	5
G.W.H.P of Haji Ali Mardan (JhandoMashaikh)	6
G.W.H.P of Hamid Ali Wassan	7
G.W.H.P of village DhaniBuxBrohi	8
G.W.H.P of Nangreja Stop	9
G.W.H.P of Stop FaizWah	10
G.W.H.P atTharee More Pirwasan	11
G.W.H.P of Rural Health Center Mirwah	12
G.W.H.P at Village Maroro	13
G.W.H.P of More Khan JogiMirwah	14
G.W.H.P of Govt. Degree College ThareeMirwah	15
G.W.H.P of Garrage of KhudaBux	16
G.W.H.P of Malik Choudagi	17
G.W.H.P at village Haji Mohammad UsmanMajidano	18
G.W.H.P of Sawan Khan Majidano	19
G.W.H.P atKorki village Hajana	20
G.W.H.P atFidaHussainAwan	21
G.W.H.P of WazirUjjan	22
G.W.H.Pof Rural Health Center, ThareeMirwah.	23
G.W.H.P of Abdul SattarPhul.	24

G.W = Ground water
H. P = Hand Pump

4. CONCLUSION

The assessment of physicochemical parameters of selected water samples from twenty four various places of talukaKotdiji and Mirwah of Khairpur Mir's suggested that for drinking purposes some of the water samples are suitable but many have objectionable levels of certain parameters. Chemical analysis does not suggest their suitability for human consumption.

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