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Research Article

Assessment of physico-chemical, spectroscopic elemental, and biological analysis of sewage water of Habib Nalla in Quetta City

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Abstract
Levels of heavy metals in sewage water are essential to determine before moving to human use and the cultivation sector because of the venomousness effects of heavy metal to plants, humans and soil by uses sewage water directly or indirectly. Sewage water is being engendered at present in large amounts and amassed in wastewater treatment plant grounds in Quetta. Wastewaters of domestic are a significant constituent of urban wastewater outturn on a wastewater recharge system. For this reason, the quantity and quality of domestic wastewater have a substantial effect on the resultant defilement of urban wastewater and the successful selection of suitable reuse of wastewater technology. The study intended to quantify the number of hazardous elements in domestic wastewater to determine the average daily production of domestic wastewater and risk elements per inhabitant and quantify the proportion of households in a total load of urban wastewater in Habib Nalla, (sewages, and channel system) and reuse of wastewater. Wastewater samples were collected from six local sewer systems linked from City Nalla. It is found that the average production of wastewater from households is approximately 122 L per person per day. The results also show that the share of households in urban wastewater is approximately 61 % in the case of Cd, 33–20% in the case of Fe, Cu, K, and less than 14% for Pb, Cr, Na, Ni, Co, and Mn.

Keywords: Habib Nalla (Channel system); Heavy metals; Metal toxicity; Reuse of water; Sewage water; Toxic pollutants

Introduction

Water plays a vital role in supporting all living forms. The weight of the human body consists of 60 to 70% of water content. Scarcity of water is a great threat, besides this contaminated water contributes terrifying situations a lot not only to human health but also to other beings **[1]**. Water has standard ratios and values of chemicals and metals, according to the World health organization

(WHO), which are checked by the Water Quality Index (WQI) [1, 2]. Water can be noxious by below or above ratios of these elements. If ratios are less, dehydration will cause lethal conditions will lead to human health if the ratios increase up to 15 %. A Major component of contaminated water is Sewage effluent, which contributes a lot to polluting water [1, 3].

In Urban areas, sewage effluent is a satisfactory wellspring of water for agricultural purposes as well as for domestic use [4]. To meet these requirements convenient steps should be followed, like complete removal of suspended solids pathogenic organisms, biodegradable organic carbon, and reduction of nitrogen concentration to less than 10 mg/l [5]. Using Natural filters like soil and aquifer materials for groundwater recharge systems brings about Use for treatment [6]. For crops, some sewage pollutants are necessary so water does not require top quality; thus, sewage effluent water is used as it is [7].

Sewage wastewater can treat with a groundwater recharge system. Recharge groundwater by natural and artificial systems delivers an acceptable use of treated wastewater of good quality. In the case of Natural replenishment underground water recharge occurs gradually with too much exploitation and greater removal of groundwater [6, 7]. The rate of renewal of groundwater causes declining levels of groundwater in the long term and groundwater resource leads to eventual exhaustion; it becomes disastrously important for artificial recharge of groundwater basins in groundwater management, groundwater resources, and surface water chiefly measured as conjunctive use in the framework of assimilated water resources management [7, 8]. Groundwater infiltration basin is admirable under satisfactory geo-hydrological conditions.

Serious concerns of the world are quality and unavailability of water. Surface water and groundwater adulterate due to the rapid growth of the human population. Besides this industrialization, urbanization, and environmental degradation contributes a lot in contaminate this water [9, 10]. A healthy and pure intake of water is good and mandatory for all living beings for their survival. But day by day water quality becomes an issue, organic and inorganic heavy metals impure the natural quality of water which caused life threatens diseases [2, 10, 11].

From the heart of the City Nalla (sewage effluent) is running and finishes at the general areas of Kharotta-Abad passing from Jinnah town areas. Requirements for fresh water come to be gradually high with dearth, inaccessibility of fresh water, progression in industrial development, and hasty growth of population. For this Domestic users are obligated to drag the groundwater from connected areas of the City Nalla. These thickly populated areas are under investigation, so the high amount of effluent becomes part of Nalla. These areas have extremely disturbed water quality, and the health of living being is at a disastrous stage, it is greatly required to treat first to stop the tragic effects of contaminated water. From Mainstream to the tail point of City Nalla, different areas are understudies and heavy metals are going to be analyzed.

City Nalla which runs in the middle of the city carried all flush and sewage water of Quetta city. The east and west fields used this water, and water also recharged the groundwater. Quality and quantify effects of sewage water on groundwater and agriculture have great significance [8, 11, 12]. Both of them directly upset the health of people of Quetta City.

Methods and Materials

Solutions and reagents

During the analysis, analytical grade reagents, and standards were cast off. All apparatus was washed with de-ionized water, and cleansed with acids with (20% HCl). In the course of examination absolute solution of 0.5 M nitric acid was used. By using atomic absorption standards of 1000ppm and dilution with 0.5 M nitric acid further standards were prepared [5].

Site selection for sampling

The samples were collected from different six sites of Habib Nalla of Quetta city (Jinnah Road, Shabaz Town, Jinnah Town,
End Habib, Nalla, BMC junction Nalla at karottabad, Airport Road). Water sections were placid in one day as of six dissimilar spots of Habib Nalla. Plastic bottles with screw caps were used to keep water samples safe. Different physico-chemical parameters and heavy metals were tested for these samples. These samples were kept carefully staying out of any kind of dregs samples and before going to the field boric and hydrochloric acids were cast off as preservatives in the sampling bottles for heavy metals [13].

Collection and preservation of samples

The study was conducted in September 2021; sampling details are given below (Table 1). From the running system of Nalla six sites were selected to collect samples. Each Collection consisted of 1.5 liters of sample. After collecting samples, it is first filtered through Whatman filter paper. They prepared according to a standard procedure (1995). Collected samples were stored in sterile, antibacterial Plastic bottles and were accurately characterized [14]. After this, they were directly led to the Analytical Lab the University of Baluchistan.

Table 1. Sample collection details; Date 5th September 2021

S. No.	Sampling date	Sample series	Sample sites
1.	5th September	Sample. 1	Main areas of Jinnah road
2.	5th September	Sample. 2	Shebaz Town
3.	5th September	Sample.3	Jinnah town
4.	5th September	Sample.4	Kharot Abad
5.	5th September	Sample.5	BMC junction kharotabad
6.	5th September	Sample.6	Airport Road

Sample preparation

In a 125 mL conical flask, a 100 ml portion of each sewage water sample was poured, about 10 milliliters of concentrated HNO_3 were added, and the prepared solution was then gently but surely heated on a stove till the volume reduces to half. After cooling at room temperature, an additional 5 mL conc. HNO_3 was added. Boiling sustained as desirable consecutive addition of 5 mL portions of HNO_3 (conc.) until digestions were done. Already solution was warmed for another addition of 5 mL NaOH (5 M) and then strained through a Whatman No. 1 filter paper. The filtrate was transported to a 100 mL volumetric flask and doubled with distilled water up to the marked volume. Double distilled water was used as a reagent blank and preserved alike a sample [13].

Instrumentation

The sewage samples remained investigated for finding lead, cadmium, Nickel, Iron, Copper, cobalt, Manganese, sodium, and potassium via atomic absorption spectrometer. The machine was permitted to become stable for 35 minutes. Later, the actual examination of samples was conducted by dint of running blank and standard solutions. (AOAC, 2000) [14, 17].

Sample collection for coliform count

Six different spots were selected for water samples collected from City Nalla using a sterile glass bottles. Within six hours of its collection water was processed in the laboratory.

Total coliform and fecal coliform count

Membrane filtrations are used for total coliform count and fecal coliform count. For the MF technique, sterile M-endo agar was used. 2-fold dilution was made from water samples and filtered in aseptic conditions using membrane filtration apparatus. The filtration was done by cellulose membrane of pore size 0.45µm. Sterile forceps were used to transfer the filter paper to M-endo agar. For total coliform screening the M-endo agar was incubated at 37 ºC for 24 hours and for fecal coliform screening it was incubated at 44.5 ºC for 24 hours. The samples were processed in triplicates. The unfiltered samples were processed directly on M-endo agar and the plates were incubated at 37 ºC for total and 44.5 ºC for fecal coliform for 24 hours. Colonies were then seen after incubation and the results were expressed in cfu/100ml [18, 21].

Results and discussion

In order to evaluate the effects of Nalla on the quality of water in Quetta city Present study were conducted. As the lifespan is at high risk of water pollution [22], so this has a chief concern related to all beings, and need to evaluate the water quality [14]. To attain the goals of the study six altered sites were selected at the Habib Nalla i.e., starting point (Jinnah Road), main point (Shebaz town), and Jinnah town, End of Habib Nalla, BMC (junction Kharot Abad) and (Airport Road). Attained samples were then opened up to physico-chemical analysis and results were arranged in a system of tables. Obtained results matched with Provisional Guidelines of Drinking Water, World Health Organization, and Pakistan National Standards for Drinking Water Quality-2010 [23].

Physical parameters

Physico-chemical parameters were noted for six sites, they stood away from normal ranges, results are shown in (Table 2) and were determined as noxious for the agriculture sector, fish, and human health, according to WHO and Khan, 2008, normal ranges for these are; pH should be in the range of 6.5-8.5 and TDS, alkalinity and hardness must be an array of 50-250 mg/mL. Similarly, the standard value for electrical conductivity is 5-15 mg/mL. Results are shown in (Table 2). By means of a fragment of environment and obligatory for life processes, all these parameters have their own significance. For example, coagulating process of chemicals and the amount of acid-base equilibrium succeeded by water-dissolved compounds is dependent on pH [24]. Likewise, alkalinity, hardness, EC, and TDS are also limiting factors with a chief role in living beings and are of key importance for definite lifespan procedures [25]. Thus for the agriculture sector, fish and human health acknowledgment of their levels is required. Anthropogenic activities and civic litter make the water quality venomous and dangerous for all beings [26].

Chemical parameters

Samples were investigated and the results are given in (Table 3). According to WHO, PAK PSQA, EU, and US EPA, normal ranges (mg/L) for heavy metals are as follows i.e. Iron (0.30), Manganese (0.1), cobalt (0.05), lead (0.01-0.015), Sodium (200mg/L), Cadmium (0.01-0.005), Copper (0.05-2.0), Nickel (0.02) and Potassium (3-5g/day), respectively [27]. The study exposed that heavy metals stuffing in Habib Nalla are away from the normal range and extremely dangerous for all beings.

Biological parameter

The total coliform and fecal coliform bacteria were counted by the membrane filtration

method. Results (Table 4) indicated that filtered and unfiltered samples contain coliform and fecal coliform bacteria abundantly [28].

Table 2. Physico-chemical properties of Habib Nalla recorded at different Sites

Sample	Temp.	pH	TDS	Hardness	Alkalinity	E.C
1	20.5	8.20	430.0	245.0	350.0	1150.00
2	20	8.25	445.0	280.0	355.0	1210.00
3	19	8.30	450.0	330.0	360.0	1200.00
4	22	8.30	465.0	255.0	370.0	1450.00
5	21	8.40	550.0	290.0	365.0	1070.00
6	19.5	8.35	570.0	320.0	345.0	1020.00
Mean	20.3	8.3	485	286.67	890	1183.33

Temperature: ºC; pH; TDS (total dissolved solids): ppm; Hardness: ppm; Alkalinity: ppm; TDS (total dissolved solids): ppm; EC (electrical conductivity): us/cm

Table 3. Analysis of Heavy metals of collected water samples from different sites conc.in mg/L

Samples	Ni	Cd	Cu	Na	Pb	Fe	Mn	K	Co
WHO,s limits	0.02	0.01	0.05	200mg/L	o.o1	0.30	0.1	4.7g/day	0.05
1	0.14798	0.010927	0.081266	91.3671	0.092492	0.432768	0.335117	38.098	0.8870
2	0.12303	0.015363	0.071534	93.13651	0.088893	0.883057	0.339164	37.009	0.8997
3	0.11867	0.007007	0.081659	92.20594	0.148383	0.403657	0.295036	35.9987	0.8097
4	0.07609	0.021862	0.094328	94.61226	0.168484	0.657971	0.41705	37.888	0.8762
5	0.08442	0.018738	0.136997	95.49241	0.216287	4.025091	0.48352	37.986	0.6547
6	0.07558	0.030743	0.103596	90.4855	0.085067	0.305823	0.305823	40.786	0.7986

Table 4: The coli form and fecal coli form count

Sample	Filtration method		Directly inoculated Samples	
	Total Coliform Count	Fecal Coliform Count	Total Coliform Count	Fecal Coliform Count
	CFU/100ml			
A	$1x\ 10^5$	$1x\ 10^4$	$1x\ 10^5$	$1x\ 10^4$
B	$1x\ 10^4$	$1x\ 10^3$	$1x\ 10^4$	$1x\ 10^3$
C	$1x\ 10^4$	$1x\ 10^3$	$1x\ 10^5$	$1x\ 10^5$
D	$1x\ 10^5$	$1x\ 10^4$	$1x\ 10^5$	$1x\ 10^4$
E	$1x\ 10^4$	$1x\ 10^2$	$1x\ 10^4$	$1x\ 10^2$
F	$1x\ 10^5$	$1x\ 10^4$	$1x\ 10^5$	$1x\ 10^4$

Note: CFU= Colony forming unit

Conclusion

By examines of domestic wastewater samples from six local sewer systems in City Nalla, the mean values of the hazard elements production were determined. The amounts of the hazard elements were assessed to be 6.453 mg for Fe, 481.895 mg for Na, 1.920 mg for Mn, 37.9609mg for K, less than 1 mg for Cu, Pb, Ni, Co, and Cd. and the data published is so far in other countries, especially in the case of Fe, Mn, and Na and there are major dissimilarities between the determined values of hazard elements in the Quetta city (Pakistan). The reasons for these dissimilarities are the different type of wastewater consumption, socio-economic situations, and quality of drinking water, household substructure, and standards of lifestyle. Consumption of water for laundry, and washing dishes may flush toilets and commercial use of non-portable water may be another possible cause of considerable variability in the assembly of hazardous elements.

Authors' contributions

Conceived and designed the experiments: R Mariyam & AUR Kakar, Performed the experiments: R Mariyam., Analyzed the data: R Mariyam, Contributed materials/ analysis/ tools: R Mariyam, S Khan, N Khan & AUR Kakar, Wrote the paper: R Mariyam.

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