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An Assessment of Ph, Toxic and Essential Chemical Elements in Water by Analytical Techniques.

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Abstract

Water quality and safety assessment has become essential in water resource studies. Water is an important substance in all aspects of life. Therefore, it must have beneficial compositions and ensure sustainable purity. Water quality monitoring is essential for the protection of public health. Sediments and pollutants in water could harm the organisms in the water body. Polluted water is a complex global problem affecting human and animal health, agriculture, and industry. Water could be affected and contaminated by toxic elements. Toxic element pollution is a serious environmental problem and a hazard that can be monitored in water. Technologies were developed to assess the essential and toxic elements in water. Inductively coupled plasma atomic emission spectrophotometry (ICP-AES) has been used to analyze water and determine water quality. The results show the total concentration of all elements: 0.001-0.0042, 0.0095-0.004, 0.0066-0.0042, and 0.0923-0.078 mg/L for mercury, arsenic, cadmium, and lead, respectively. Physical and chemical properties of water samples, such as pH, salinity, TDS, EC, turbidity, and DO, were measured.

Keywords: Water assessment, Toxic elements, Essential elements, ICP-AES.

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Introduction

Water is a significant source of life and population growth [1]. It is an essential substance for all various life purposes and uses [1,2]. Natural disasters, global warming, and climate change have increased water demand, especially drinking, which is considered a source of many elements for human consumption [3]. Harmful and toxic suspended matter could contaminate water because supply pipes affect water quality [2]. Some highly efficient treatments to reduce quantities of poisonous elements must be done for water because of increasing pollutants and demand for water for all purposes [3].

Heavy metals are dissolved in water and can also be found as particulates. Some heavy metals at high doses cause harmful effects on the human body, such as mercury, arsenic, lead, cadmium, and chromium, which have a delirious impact on human metabolism [4]. Heavy metals could exist in water because of forest fires, volcanoes, erosion of rock, and artificial

reasons such as agricultural activities [5]. Assessment of pollutant effects of water is critical due to water's importance in life [6]. In addition, some parameters, such as pH and conductance, influence the concentration of heavy metals in water [5,6].

This article presents the quantities of trace elements and focuses on water analysis, which is very important regarding toxic elements. Arsenic in water exists through four species (arsenate (As5+) and arsenate (As3+). These ions act as the total concentration of arsenic in water. Mercury can be found in water as organic and inorganic compounds. Cadmium exists almost as chloride species $CdCl_2$, $[CdCl_5]^{3-}$, these ion's ability to form complex compounds increased by increasing water salinity. These complex compounds depend on the pH value of acidic water. [4,7]. Lead was found as cation (Pb^{2+}), which forms $PbCO_3$ and $Pb(OH)_2$ under alkaline conditions [8]. Mercury and arsenic were analyzed by inductive coupled plasms technique (ICP-AES), while lead and cadmium were identified by (ICP-AAS) [4].

Materials and Methods

Water samples examined in this study included ten samples collected from different locations in Iraq, specifically from the Kerbala governorate. Toxic and essential elements have been assessed, and pH has been adjusted for the collected samples. Digestion was done for the samples by transferring 100 ml of each sample to a conical flask, then added 5ml of Nitric acid to the solution and covering it; the solution was heated on a hot plate (almost dry) and added 5ml of nitric acid was added to complete the digestion process the volume was completed to 50ml by deionized water. Furthermore, a blank solution was used to calibrate the instrument. Mercury and arsenic concentrations were measured by (ICP-AES) technique, while (ICP-AAS) was used for measuring total cadmium and lead [4,9].

Result and Discussion

Water's physical and chemical properties are shown in Table (1) [10], which illustrates the pH value at (7.47-7.4) and within the acceptable limits of (EC, 1998). Electric conductivity is measured to identify water quality [11,12]. The electrical conductivity for all samples was measured as shown in Table (1), which was (43.3 -23.1 mS /cm).

Total dissolved solids and salinity have recorded the highest and lowest values (28000-16400 g/l) and (21.5-17.7 ppt), respectively. Turbidity has been measured to indicate water quality, which was recorded (at 12.2-95.3 NTU). Suspended matters in water have been measured to identify water turbidity [13,14]. Dissolving oxygen is another critical parameter affected by increasing pollution [15,16]. Dissolved oxygen was measured as (5.91-4.43 mg/l). In addition, oxidation-reduction potential (ORP) is an important parameter, especially in the disinfection field for water [17,18]. Therefore, it is measured to identify dissolved oxygen in water.
ICP-AES and ICP-AAS techniques have been used to measure toxic elements in water, such as Mercury, Arsenic, Cadmium, and lead [4,19], as shown in Table (2). Mercury exists in the environment naturally and anthropogenically through lithosphere, hydrosphere, atmosphere, and biosphere sources [20]. Some of Mercury's chemical states are toxic, and some are non-toxic. Therefore, it's entered in some drugs [21,22]. However, increasing mercury levels cause risks to human health.

Arsenic is a widely distributed element in water; its concentration ranges from 0.0095-0.004 mg/L and depends on some anthropogenic factors. In nature, arsenic exists in the oxidation states of arsine (-3), arsenic (0), arsenite (+3), and arsenate (+5). Arsine (-3) and arsenic (0) are

found rarely in nature; arsenide and arsenate are the most common valence states in waters, and arsenic concentration was within the acceptable limits of EC (1998).
Cadmium and lead are toxic elements in environment, they were measured in all water samples by using flame atomic absorption spectroscopy and their existence in nature depend on some factors [23,24]. Some their compounds are soluble in water therefore they cause some hazards on human health [4,24]. The total concentrations are ranged between (0.0066-0.0042) and (0.0923-0.078) mg/L for cadmium and lead respectively as shown in table2 and their results were within the acceptable limits of (EC, 1998).

Table 1: Physical and chemical properties of water samples.

Samples	pH	Water Temp. (ºC)	Salinity (ppt)	TDS (mg/L)	EC (mS cm^{-1})	Tur. (NTU)	DO (mg/L)
1	7.47	19.11	21.5	28000	43.3	12.2	5.91
2	6.83	19.5	21.4	29500	45.8	7.6	6.13
3	7.38	17.81	20.1	26900	41.6	156	5.87
4	6.68	22.33	23	28200	43.6	144	5.6
5	7.4	21.9	18.1	24300	37.1	64.7	4.64
6	7.24	21.46	15.1	21900	33.1	40.5	4.6
7	7.49	21.37	16.8	23200	35.5	72.5	4.4
8	7.4	22.23	17.7	16400	23.1	92.3	4.43
9	7.39	22.23	17.8	16400	23.1	92.3	4.43
10	7.4	22.23	17.7	16400	23.1	95.3	4.43

Table 2. Concentration of Mercury, Arsenic, Cadmium, and Lead in the samples of water.

No. of samples	Conc. of Hg mg/l	Conc. of As mg/l	Conc. of Cd mg/l	Conc. of Pb mg/l
1	0.001	0.0095	0.0066	0.0923
2	0.0041	0.001	0.0048	0.08461
3	0.005	0.006	0.0045	0.08461
4	0.004	0.008	0.0045	0.1
5	0.001	0.007	0.0048	0.0846
6	0.001	0.0057	0.0063	0.0769
7	0.0022	0.0068	0.0048	0.0923
8	0.0043	0.0057	0.0051	0.0922
9	0.0042	0.0042	0.0048	0.0832
10	0.0042	0.004	0.0042	0.078

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