Determination of Monthly Changes in Some Water Properties of Lake Sureat

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Author's contribution

The sole author designed, analysed, inteprted and prepared the manuscript.

Original Research Article

ABSTRACT

In this research, the concentrations of some properties of the water of Lake Sureat were determined during a whole year, such as temperature, pH, electrical conductivity, oxidation and reduction potential, and Polycyclic Aromatic Hydrocarbons (PAHs) to evaluate the possibility of using it for human consumption. Therefore, in this research, water samples were collected from Sureat Lake during the whole year, and extracted and studied quantitatively and qualitatively using the technology of gas chromatography/ spectrometry mass (GC-MS) in order to determine the PAHs concentrations during the seasons of the year. The results showed that the temperature, pH, electrical conductivity, oxidation and reduction potential were within the permissible limits for drinking water, while the total concentrations of PAHs were greater than the permissible value in drinking water sources. They were high in winter, their values were 550.6 ng/L. ∑PAHs recorded a low value in the summer, it was 308.47 ng/L. PAHs with low molecular weights (3-4 rings) were dominant in the water samples during the study seasons, which poses a threat to human life.

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1. INTRODUCTION

Water of lakes, springs and wells is considered one of the most important water sources used for drinking purposes, and constitutes the primary resource for meeting the needs of the growing population. Population growth and industrial, commercial, craft and service development have led to the contamination of these sources with various forms of organic and inorganic pollutants. These pollutants may reach living organisms and accumulate through the food chain, causing disruption in the ecosystem [1].

Persistent organic pollutants (POPs) are considered one of the most dangerous forms of pollutants found in water sources used for drinking purposes, therefore they have raised great concern among governments in many countries of the world [2].

POPs are toxic compounds including industrial chemicals, polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides, pharmaceuticals, hormones, textile dyes, dioxins and furans [3].

Polycyclic Aromatic Hydrocarbons (PAHs) are considered (POPs), and semi-volatile organic compounds. PAHs are considered among the most important and dangerous environmental pollutants according to the United States Environmental Protection Agency (USEPA) and the European Union (EU) [4,5].

(PAHs) compounds cause cancers and hereditary genetic mutations according to the World Health Organization [6,7]. They are difficult to biodegrade, so they remain in water for many months and years. Also, when chlorine is added to polluted water, trihalomethane compounds (THMs) will form, which are toxic and very dangerous [8]. Therefore, in this research, we studied and identified the (PAHs) compounds in the water of Lake Sureat, which can be used for drinking.

2. THE IMPORTANCE AND AIMS OF RESEARCH

The importance of the research lies in evaluating the contamination of drinking water sources with (PAHs) to assess its environmental risks to humans. The research aims to determine the concentrations of some properties of the water of Lake Sureat, such as temperature, pH, conductivity, oxidation and reduction potential, and Polycyclic Aromatic Hydrocarbons (PAHs).

3. MATERIAL AND METHODS

3.1 Description of the Study Area

Sureat Lake is located in Baniyas city in Syria as shown in Fig. 1. There are many agricultural and industrial activities in the lake's feeder basin, which contribute to the pollution of the lake with (PAHs) compounds [9].

Fig. 1. Location of Sureat Lake on the map in Syria

3.2 Sample Collection, Extraction and Analysis

Water samples were collected from Lake Sureat from July 2023 to June 2024, and some of their properties were determined, such as temperature, pH, conductivity, and oxidation and reduction potential by using a measuring device PCT-407 Portable pH Conductivity TDS Meter. Subsequently, samples were kept in opaque glass containers that previously were cleaned with organic solvents (regular hexane and dichloromethane) to determine PAHs. The samples were extracted directly by the extraction method (liquid-liquid) with two-liter separating funnel and using 80 ml of a mixture of two systemic organic solvents (Hexane: Dichloromethane) in a ratio of (1:1). Then the organic extracts were concentrated using a rotary evaporator up to (10 ml) then a nitrogen gas up to (1 ml) to be ready for the separation and purification process [10]. Thereafter, organic extracts were analyzed quantitatively and qualitatively by using the technology of gas chromatography/ spectrometry mass (GC-MS) to determine the PAHs concentrations in the laboratories of the Higher Institute of Marine Research at Tishreen University in Syria.

4. RESULTS AND DISCUSSION

4.1 Water Temperature

The highest value of water temperature in summer was 20.5 °C in August, and the lowest value of 10.3 °C in winter was in February, as shown in the (Fig. 2). It was noted that there is a difference in temperature and an effect of ambient air temperatures during the summer and winter seasons [11].
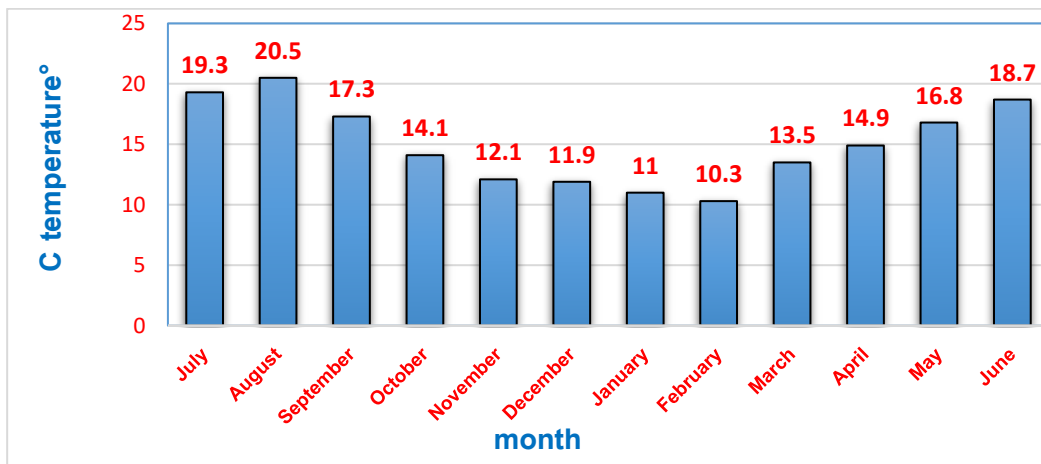
4.2 pH

pH values in the studied water ranged between 6.5 in October and 7.89 in January, as shown in the (Fig. 3), which reflects the basic nature of the aquifer water, which can be attributed to the dominance of carbonate and bicarbonate ions, and the nature of the rocky excavations that water passes through the groundwater aquifers that feed the lake. the decrease in pH values in periods of drought is due to the lake's water being affected by human activity, such as sewage, in addition to the drainage of restaurant liquid waste located near it.

4.3 Electrical Conductivity (EC)

EC values ranged between 482 µs/cm in June and 569 µs/cm in March, as shown in (Fig. 4). This difference in conductivity can be attributed to the rain, which stimulates the dissolution processes of carbonate rocks, electrolytes, and salts in the study area, and may cause an increase in conductivity values in the winter and spring, while a decrease in these values in the periods of drought indicates weak dissolution processes for limestone rocks [12].

4.4 Oxidation and Reduction Potential (ORP)

(ORP) expresses the activity of the oxidizing and Regeneration substances in the water. The values of (ORP) ranged between 18.1 mv in July and 26.1 mv in March, as shown in (Fig. 5). This difference can be attributed to the increase in the activity of oxidants in winter and spring.
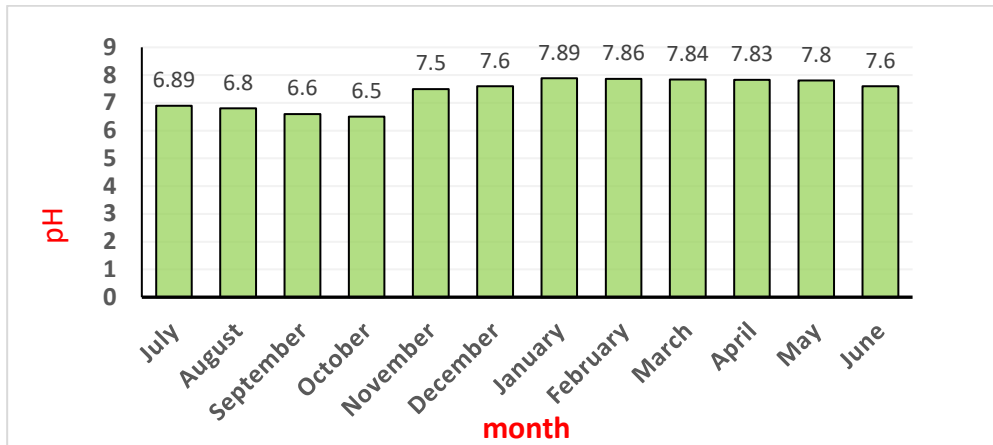

Fig. 2. Monthly temperature changes in the waters of Lake Sureat

Fig. 3. Monthly changes in pH values in the waters of Lake Sureat
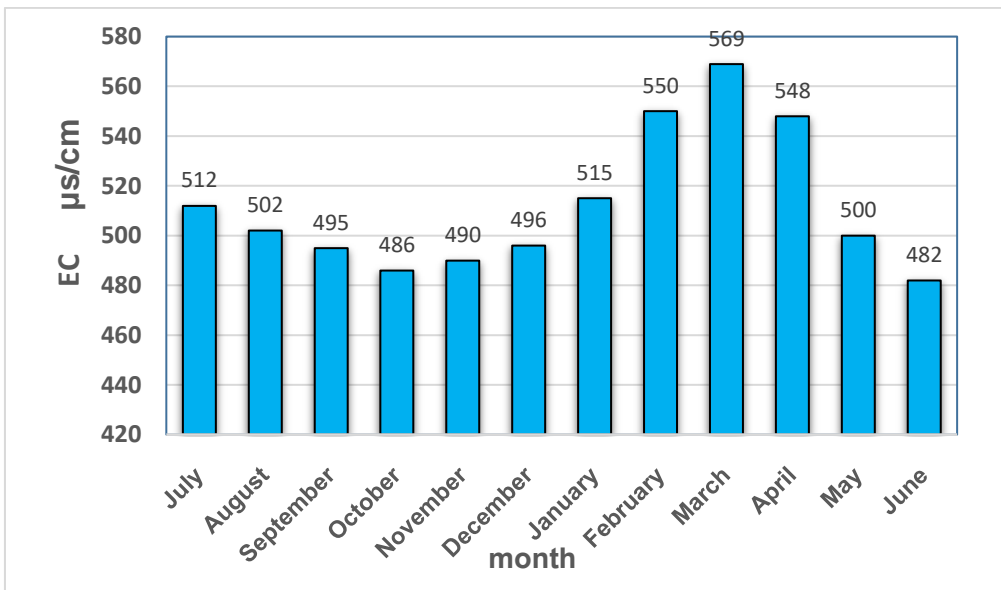

Fig. 4. Monthly changes in electrical conductivity in the waters of Lake Sureat
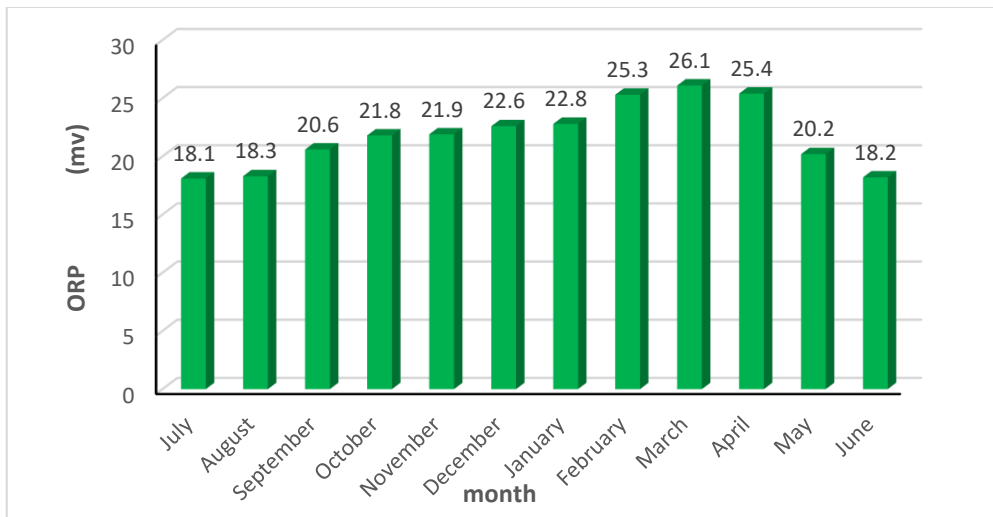

Fig. 5. Monthly changes of ORP in the waters of Lake Sureat

4.5 Determination of Concentrations of Polycyclic Aromatic Hydrocarbons (PAHs)

The results of the measurements showed that the highest value of the total concentrations of Polycyclic Aromatic Hydrocarbons (∑PAHs) was (550.6 ng/L) in February in the winter, and the lowest value was (308.47 ng/L) in August in the summer. Average values of (∑PAHs) during the seasons of the year were: 493.4, 481.3, 378.45 and 339 ng/L in Winter, Spring, Autumn and Summer respectively as shown in (Fig. 6) and (Fig. 7).

When studying the concentrations of PAHs according to the number of their aromatic rings, we found that PAHs with low molecular weight (3-4 rings) were more dominant in the studied water than PAHs with high molecular weight (5-6 rings), this is explained to their high solubility compared to high molecular weights and this percentage was greater in the winter compared to the rest of the seasons, as shown in (Fig. 8), due to lower temperatures, which leads to a decrease in the rate of its volatility and biodegradation [13].

By comparing these results with the concentrations of PAHs in the waters of other regions of world, it was found that the concentrations recorded in this research was a convergence in concentrations recorded in the surface waters of Diyala River in Iraq [14], while a significant decrease in concentrations was observed from the values in Lake Lagos in Nigeria [15], and the recorded concentrations were greater than the observed values in drinking water in cities in China [16].
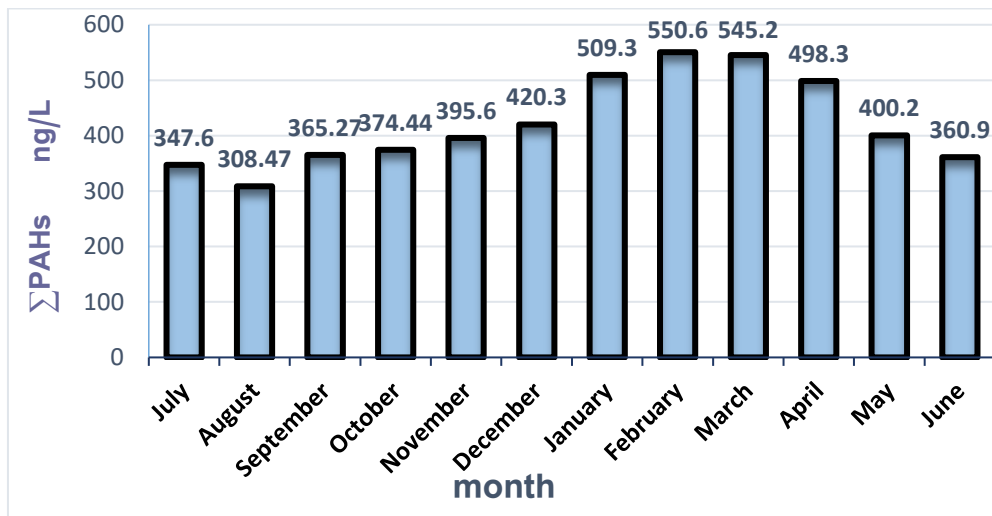

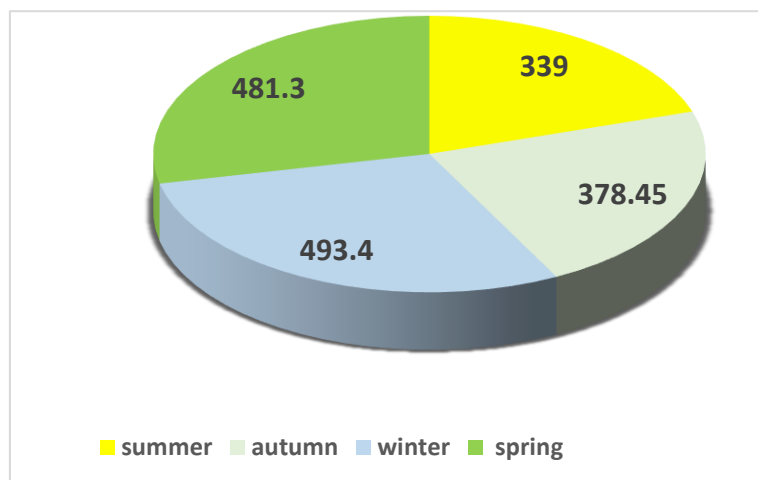**Fig. 6. Monthly changes of (∑PAHs) in the waters of Lake Sureat**

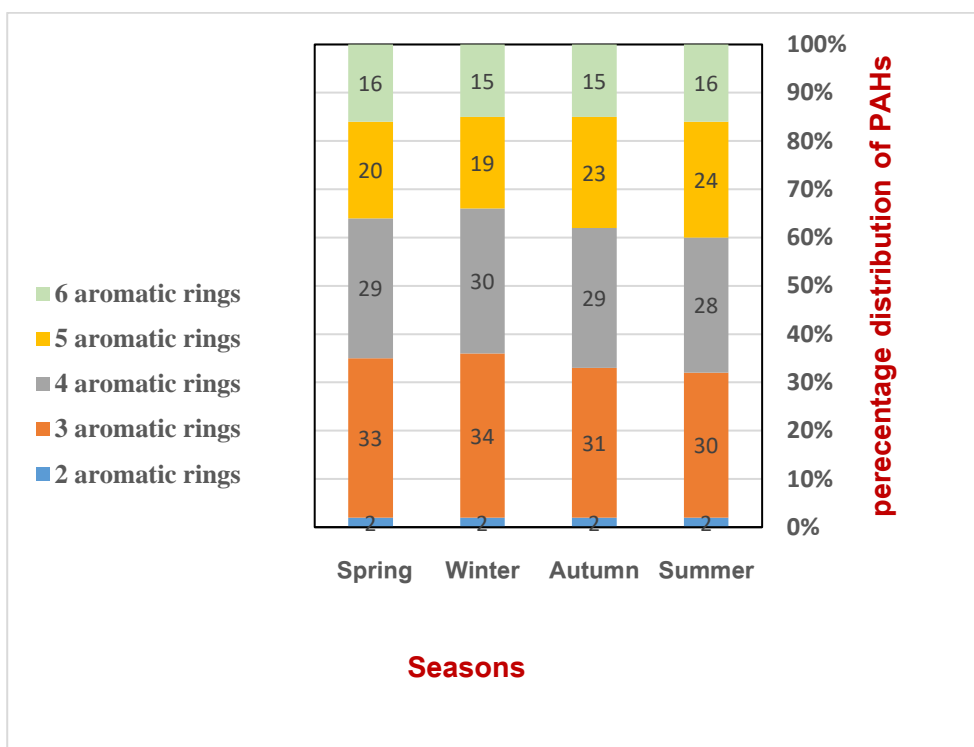**Fig. 7. Seasonal changes of (∑PAHs) in the waters of Lake Sureat**

Fig. 8. Percentage distribution of PAHs according to the number of their aromatic rings

5. CONCLUSIONS

The results of the research showed the presence of polycyclic aromatic hydrocarbons (PAHs) was observed in the water of Lake Sureat. The value of (∑PAHs) was higher than the permissible value equal to (100 ng/L) according to the Syrian standard for drinking. (∑PAHs) was recorded in the winter and the lowest in the summer compared to the rest of the seasons. That is, there is a danger threatening human life.

Therefore, it is recommended that a comprehensive environmental study be conducted to identify sources of persistent pollutant compounds in freshwater and further research be conducted to estimate the degree of contamination of lake water with PAHs and assess their potential risks.

DISCLAIME (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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