"Assay of the levels of heavy metals in Shatt Al-Arab and other rivers in Basra in 2018, and the subsequent study of the adsorptive activity of flourapatite for these metals"

- A research project
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- As a partial fulfillment for the graduation from the College of pharmacy- Basra University
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Outline

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Abstract

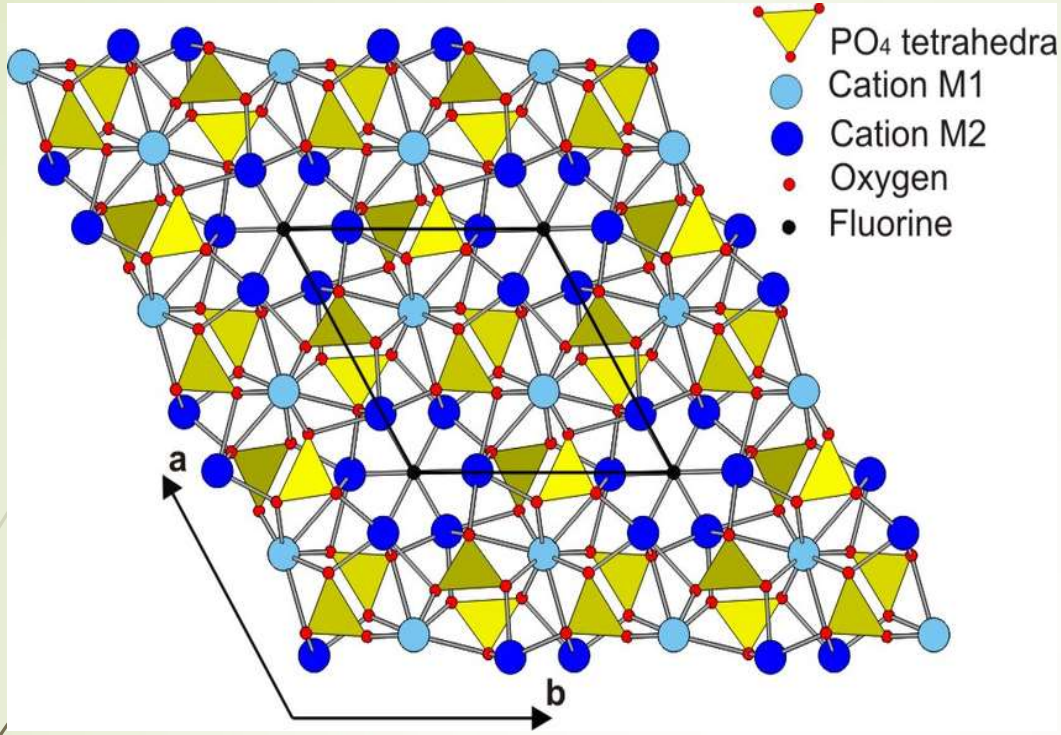
- **The measurements were performed in five different areas in Basra using atomic absorption spectroscopy. The results of copper showed an increased concentration in Alkhandak river, reached 3.1 ppm, whereas lead was increased in two areas, 15 ppm in Alkhandak river and 3 ppm in Shatt Al-Arab – Al-tanawuma region, whereas the level of Cd was found to be zero in all of the tested areas.**

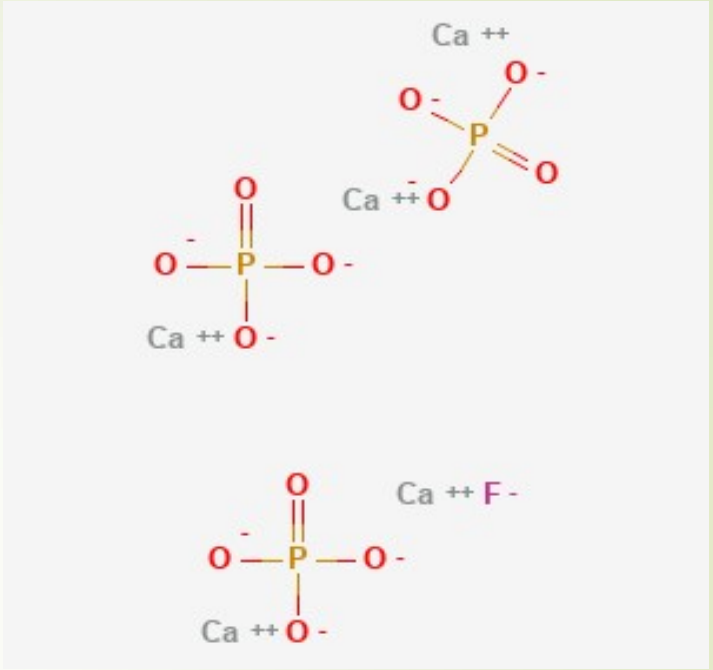
- **The adsorptive ability of flouroapatite chemical compound for Copper and lead was tested by adding the flouroapatite to the tested water samples for Cu and Pb in a ratio of 10 mg: 1 mL for each sample, storing the mixture for 24 hours. Then, the water was analyzed by atomic absorbance spectrophotometer and result showed that the water become free of these metals, except a very small amount of lead in just on place. This result indicates the outstanding adsorptive ability of flouroapatite for copper and lead, and the possibility of using flouroapatite in purification of water from these heavy metals.**

Introduction

- Due to excessive use in industry, agriculture and medicine, the heavy metals are being accumulated in environments compartments including water.Thais could cause serious threat to human life such as the harmful effects on the kidney, liver, cellular metabolism and CNS involvement that is related to toxicity of lead . On the other hand, exposure to high levels of copper may cause nausea, diarrhea, chest pains, and irritation of the respiratory tract, and very high copper doses can damage the kidneys and liver and may lead to death.

- **There are different ways to minimize the levels of heavy metals in environment sectors including water. One of these procedures is the use of substituted calcium phosphates, like fluorapatite. This inorganic chemical compound has the chemical formula of $Ca_5 (PO_4)_3F$. I**
- **Fluorapatite is available in nature, where it is present in many types of rocks, in addition to mammalian bones. Also, flouroapatite can be easily synthesized chemically. That make fluorapatite adsorption is economically more preferable than other costly techniques used in management of heavy metals**





“fluorapatite structure”

- **The aim of the present study, is to determine the levels of three metals, namely Cu, Pb and Cd in Shatt Al-Arab and other rivers in Basra, predicting whether these levels are harmful to human health or not, by comparing them with the standards of WHO. Then, evaluation of the adsorptive capability of flouroapatite compound for these estimated metals had been conducted.**

Experimental work

- **•Chemicals, Tools and Instrument.**
- **Chemicals.**
- The chemicals used in this study were of analytical grade. The concentrated HNO3 (69.5%) was from Scharlanc ,Spain , whereas the distilled water was prepared locally in marine science center- university of Basra. The flouroapatite was from Merk , USA

- **Tools and Instrument**
- Atomic absorbance spectrophotometer, Phoenix-986, SHIMADSU Co., Japan.
- Hotplate (Sirman), Italy.
- FTIR spectrophotometer, IR Affinity-1, SHIMADSU Co., Japan.
- The x-ray diffractometer, PANanalytical Co, Netherlands.

- **•Methods**
- ***Water sample collection**
- Water samples were collected in 24 - 11 - 2018 from five different areas in Basra, namely; Shatt Al-Arab in the region of Abul khasib-yusefan, Al-Ashar river, Alkhandak river, Shatt Al-arab – Al-tanawuma region and Al- Qurna city in join of Tigris and Euphrates.

- ***Measurements of heavy metals for water samples**
- Fifty milliliters from each sample were poured in a beaker, and then 5 mL concentrated HNO3 were added to them. The mixture was left for 30 minutes. Then after, the each beaker was put on hotplate and the samples were heated on 140 ^{O}C for 60 minutes until evaporation of water, where the volume of each sample became about 2 - 3 ml. After that, the samples were left to be cooled in an ambient temperature and then distilled water was added to each sample and the volume was completed to 25 milliliters. From the resulted sample, 1-2 milliliters were analyzed by atomic absorption.

- ***Identification of flouroapatite by FTIR spectroscopy**
- Five milligrams of flouroapatite was mixed with about 100 mg of KBr powder and then grounded together. Then, the mixture was pressed into disc and then FTIR spectra were recorded for each compound.
- ***Identification of flouroapatite by X-ray diffraction.**
- X-ray diffracetion technique was carried out using one gram of the synthesized flouroapatit**.** The data was recorded in the two theta range of 10^0_70^0 at. The x-ray diffractometer, with a goniometer radius equal to 240 mm, was working at a tension of 40 kv and a current of 20 mA, producing Cu radiations of K-Alpha1 [Å] = 1.54060, K-Alpha2 [Å] =1.54443 and K-Beta [Å] =1.39225.

- ***Measurements of the adsorptive ability of flourapatite for the heavy metal**
- Four hundreds milligram from flouroapatite was put in a beaker with 40 milliliters of each water sample and stored in laboratory for 24 hours at room temperature. Twenty four hours later, 20 milliliters from the supernatant layer of each sample was taken and analyzed by atomic absorption.

Result and Discussion

- **•Measurements of heavy metals for water samples**
- The data obtained for the levels of the metals in the rivers is stated in table (1). The results for copper showed a rise in concentration to an extent more than the normal in Alkhandak river, where it reached 3.1 ppm, and it was normal in the other sampling places. In concern with the lead, its concentration was higher than normal in two areas, which are Alkhandak river (15 ppm) and in Shatt Al-Arab - Al-tanawuma region (3 ppm). The cadmium was absent in all of the tested areas.
- The increased levels of copper and lead in water of Alkhandak river may be attributed to increased sources of contamination for these metals like the presence of clothes factory, in addition to the sewage and garbage that to the river came from the crowded houses and shops in this area.

- It's noticeable from table (1), that the level of lead is increased in Shatt Al-Arab – Al-tanawuma region. There are many probable causes for this increase; firstly, there are rural areas on the edge of the river in this area, and the insecticide used in agriculture can be one of the causes for the lead increased level. Also, the presence of hospital near in this region may provide medical waste that may contain Pb constituents. In addition to that, this sampling area is linked to the Alkhandak river, and there a short distance between them (about 1.5 kilometer), so the lead may come in high quantity from the high level present in Alkhandak river. Finally, the sewage of the Al-ashar buildings that are poured in this region of Shatt Al-Arab may be a cause.
- With time and without treatment of water, the concentration of these heavy metals increase to toxic level that may cause harmful effects on human health through food or drink.

Table (1): the area of sampling and the concentration detected for copper, lead and cadmium.

Sequence	Sampling Area	Copper concentration (ppm)	Lead concentration (ppm)	Cadmium concentration (ppm)
1	Shatt Al-Arab in the region of Abul khasib-yusefan	0.043	0	0
2	Al-Ashar river	0.58	0	0
3	Alkhandak river	3.1	15	0
4	Shatt Al-arab – Al-tanawuma	0.1	3	0
5	Qurna city – in join of Tigris and Euphrates.	0.09	0	0

Table (2) and (3) represent the normal concentrations of the copper and lead in the water and per body kilograms, successively.

Table (2): Normal level for heavy metal in water (8, 9).

Metal	Concentration (ppm)
Copper	1.5- 2
Lead	0.05 -0.1

Table (3): Normal level for heavy metal per kg of body weight.

Metal	Amount per kg
Copper	0.5 mg/kg
Lead	0.007 mg/kg

•Identification of flouroapatite by FTIR spectroscopy

Figure (1) illustrates the FTIR of flouroapatite. The spectra at 3132.4cm^{-1} can be contributed to the (O-H) stretching of atmospheric water impurity. The (P=O) symmetrical stretching is clear at 1026.3 cm^{-1}, whereas the (P=O) deformation presents at 594.08 cm^{-1}. These data confirm the formation of flouroapatite .

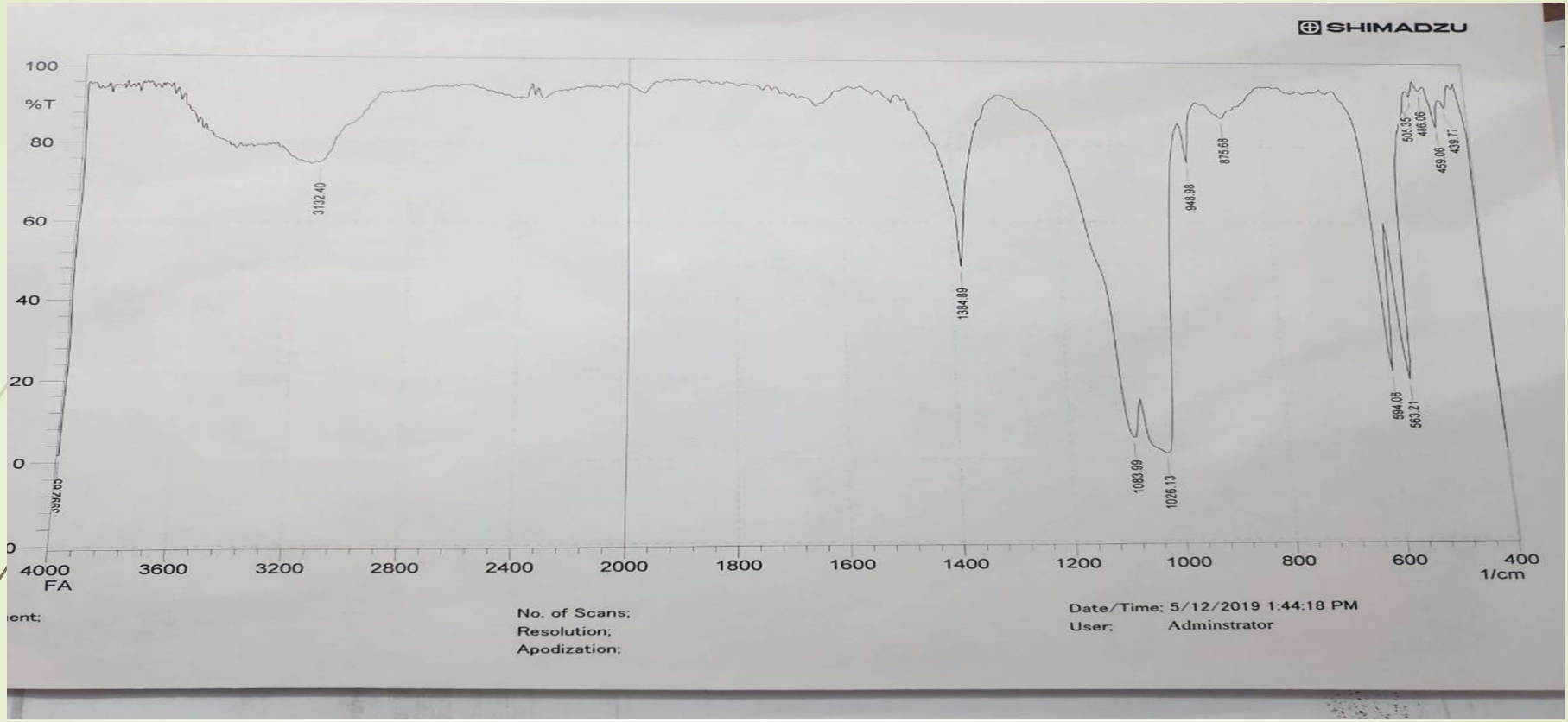
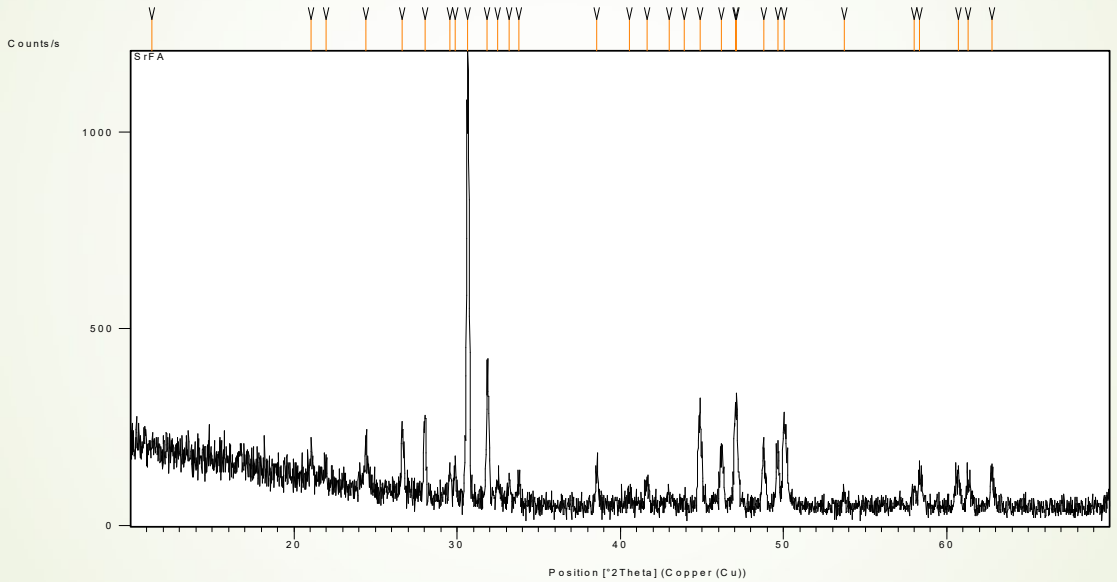


Figure (1): FTIR of flouroapatite.

- **•Identification of flouroapatite by X-ray diffraction.**
- The x-ray diffractiogram of the floroapatite is stated in figures (2). It stands in coincidence with that of the reference obtained from the literature .



- “Figure (2): X-Ray diffraction of floroapatite”

•**Measurements of the adsorptive ability of flourapatite for the heavy metals**

- **Table (4); show the concentrations of Cu, Pb and Cd after the flouroapatite treatment for the water samples.**
- **As it is clear from the results, flouroapatite showed excellent ability to adsorb heavy metal from contaminated water that become free from metal after treatment with flouroapatite in all regions, except a low concentration for lead in one sample (Alkhandak river).**
- **According to these results, it is reasonable to predict that the flouroapatite compound can be employed to decrease the level of heavy metal in water.**

Table (4): the concentrations of copper, lead and cadmium after the samples the use of flourapatite.

Sequence	Sampling Area	Copper concentration (ppm)	Lead concentration (ppm)	Cadmium concentration (ppm)
1	Shatt Al-Arab in the region of Abul khasib-yusefan	0	0	0
2	Al-Ashar river	0	0	0
3	Alkhandak river	0	0.001	0
4	Shatt Al-arab – Al-tanawuma	0	0	0
5	Qurna city – in join of Tigris and Euphrates.	0	0	0

Conclusion

- Water from Basra rivers and shatt Alarab contain heavy metal (lead and copper) in toxic levels in some regions. With time, as the sources of water contamination still active, the concentration of metal in water will increase and cause serious problems on all environment, affecting human, plants and animals. To solve this problem and decrease water contamination, flouroapatite compound, which is naturally available and easily synthesized chemically with low cost, can be used to purify water from the copper and lead heavy metals.

Thank you