



# Investigations on Pharmaceuticals and Radioactive Elements in Wastewater from Hospitals in Kuwait

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# Overview

- Introduction
- Objectives of Study
- Methodology
- Results
- Conclusions
- Recommendations

# Introduction

- Wastewater from healthcare institutions usually contains disinfectants, antibiotics, pharmaceuticals and Magnetic Resonance Imaging (MRI) contrast agents. Residues of pharmaceuticals are present in all wastewater treatment plants' effluents.
- The conventional activated sludge systems are usually not efficient for pharmaceuticals removal.
- In Kuwait, there is lack of information regarding characterization of wastewater from hospitals.
- In this study, the obtained field and lab results are compared with KEPA requirements regarding domestic wastewater effluent discharged to sewage network.

# Objective of the Study

- The objective of the study was to characterize the wastewater generated from four hospitals located in Kuwait.

# Location Map of the Study Areas



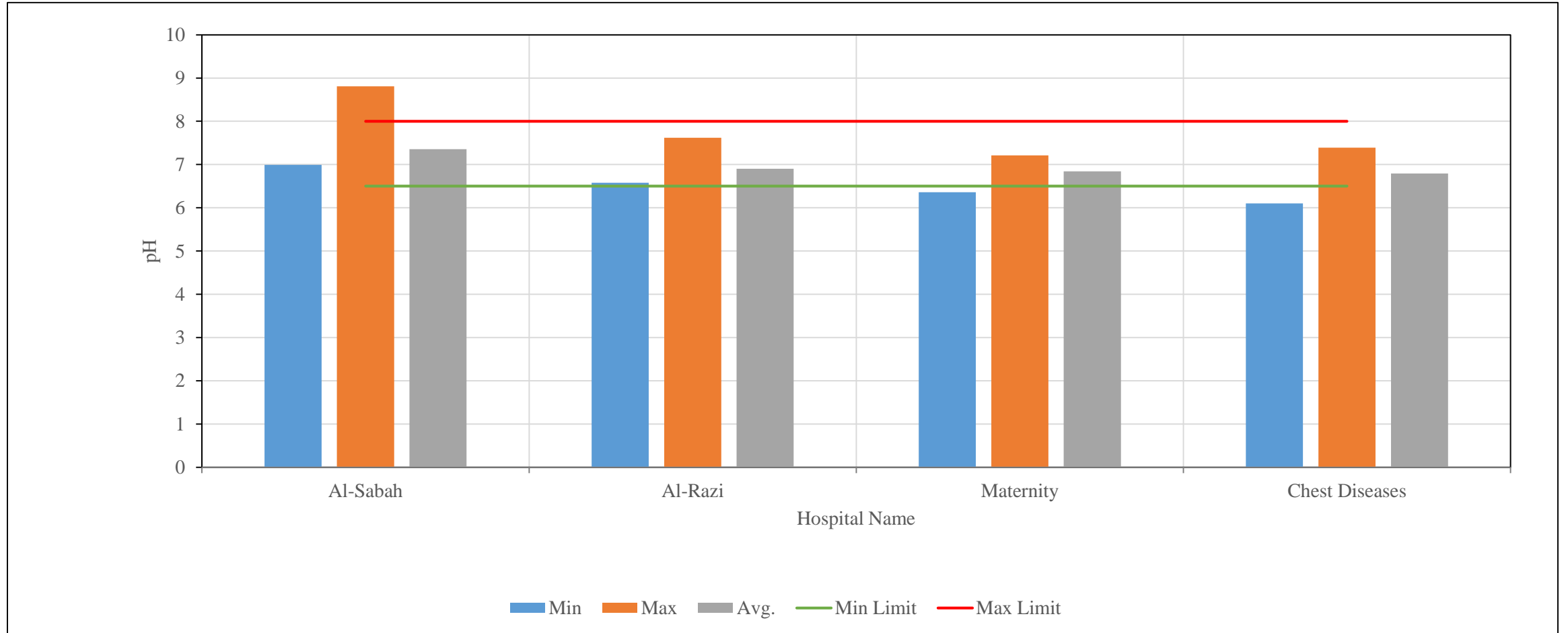
# Methodology

- Full chemical and microbiological characteristics of wastewater from studied hospitals were conducted at KISR and external laboratories.
- Prior sampling, the following wastewater parameters were examined: temperature, pH, electrical conductivity (EC) and oxy-redox potential.
- The sampling was carried out on the weekly basis from beginning of August 2019 until 31 March 2021.
- Analyses of radioactive isotopes (I-131, K-40, Tc-99m) presence were carried out by laboratory of Environmental and Life Sciences Research Center in KISR by application of gamma spectroscopy.
- Presence of pharmaceuticals (four antibiotics such as Metronidazole, Trimethoprim, Sulphamethoxazole and Ranitidine plus Paracetamol) was determined by external laboratory (Biofocus in Germany).

# Results

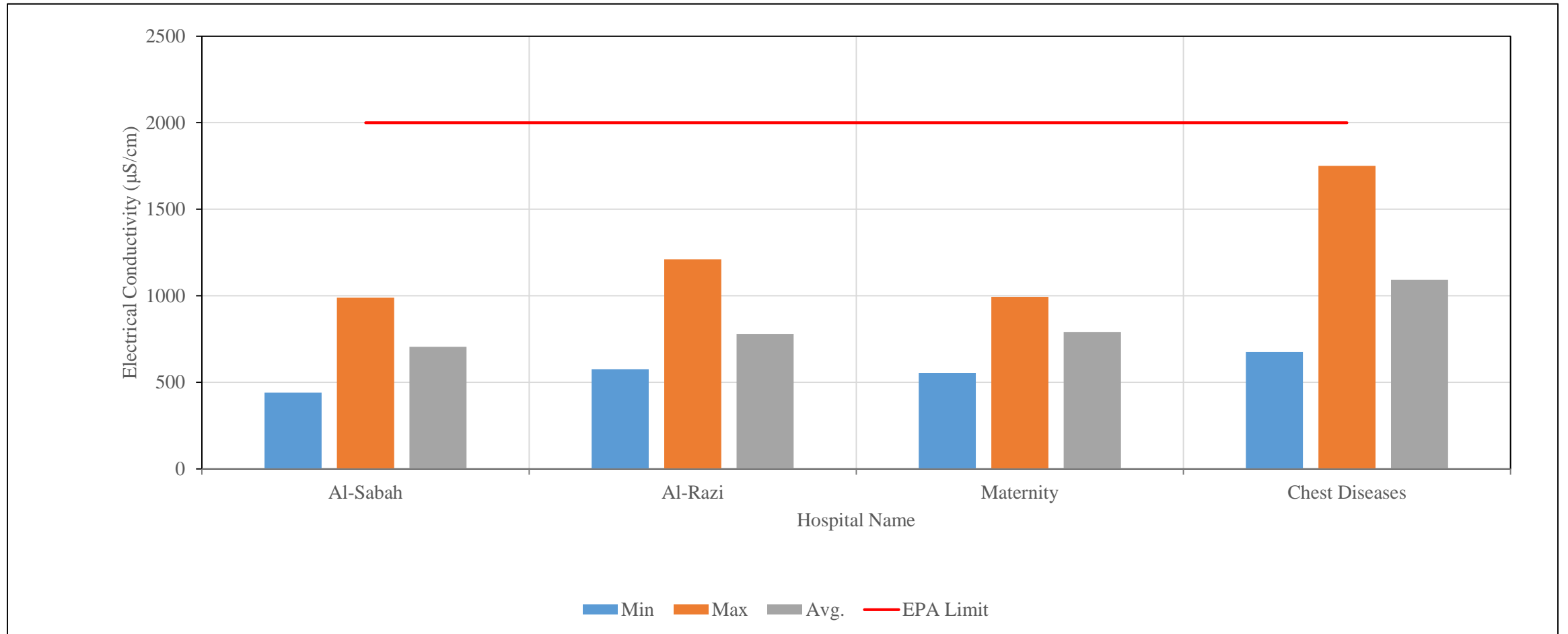
- Onsite wastewater field parameters.
- Radionuclides.
- Pharmaceuticals.

# pH variation for hospital wastewater in Kuwait

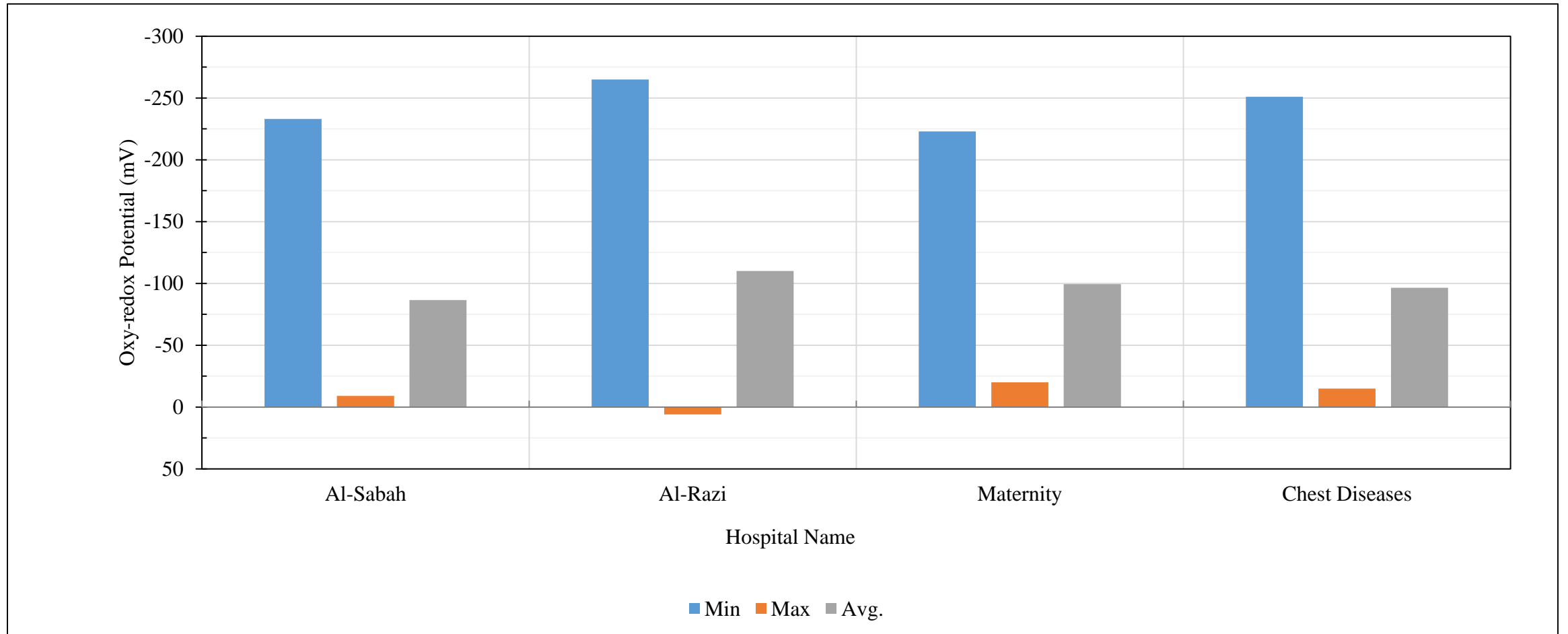




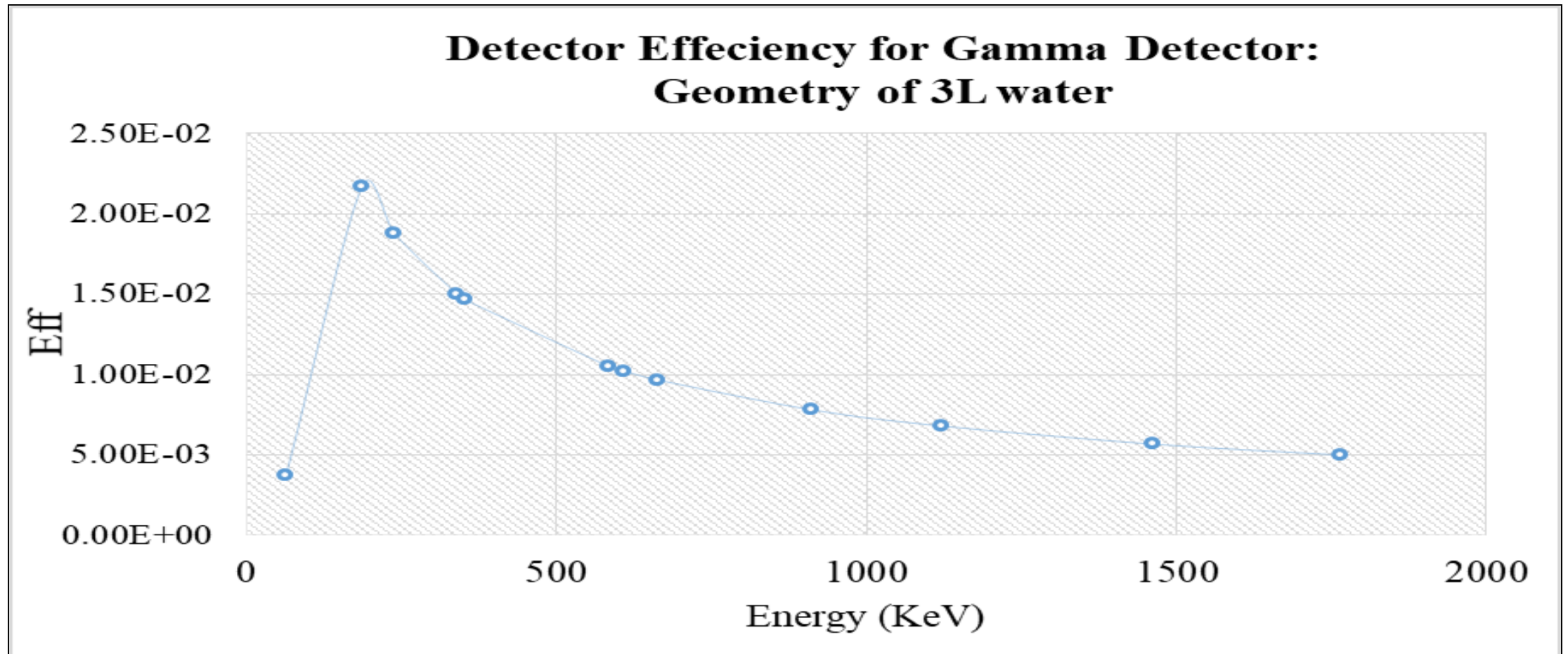
# Electrical conductivity variation for hospital wastewater in Kuwait



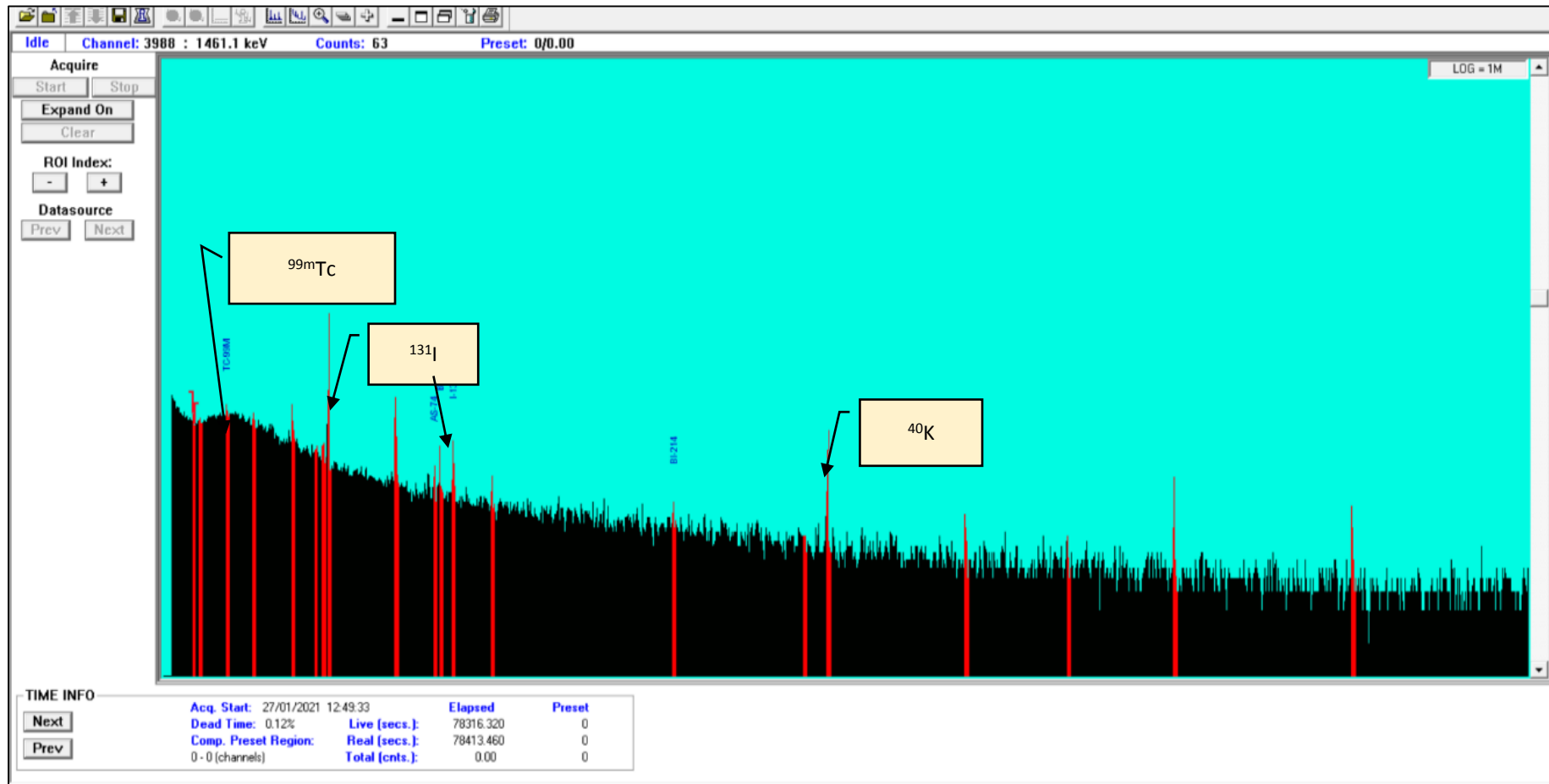
# Oxy-redox potential (ORP) variation for hospital wastewater in Kuwait



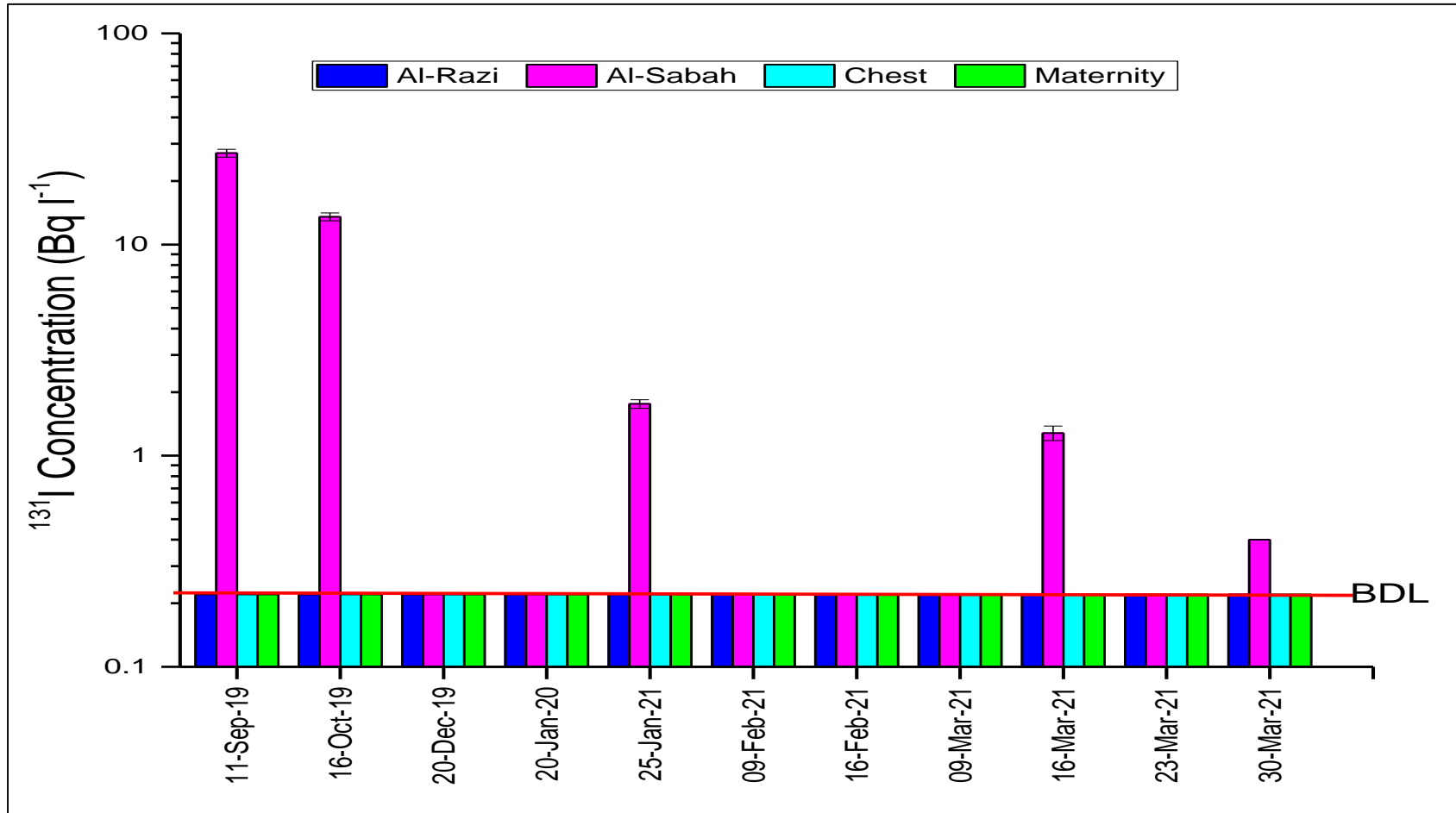
# Detector efficiency curve of the Marinelli Beaker counting geometry.



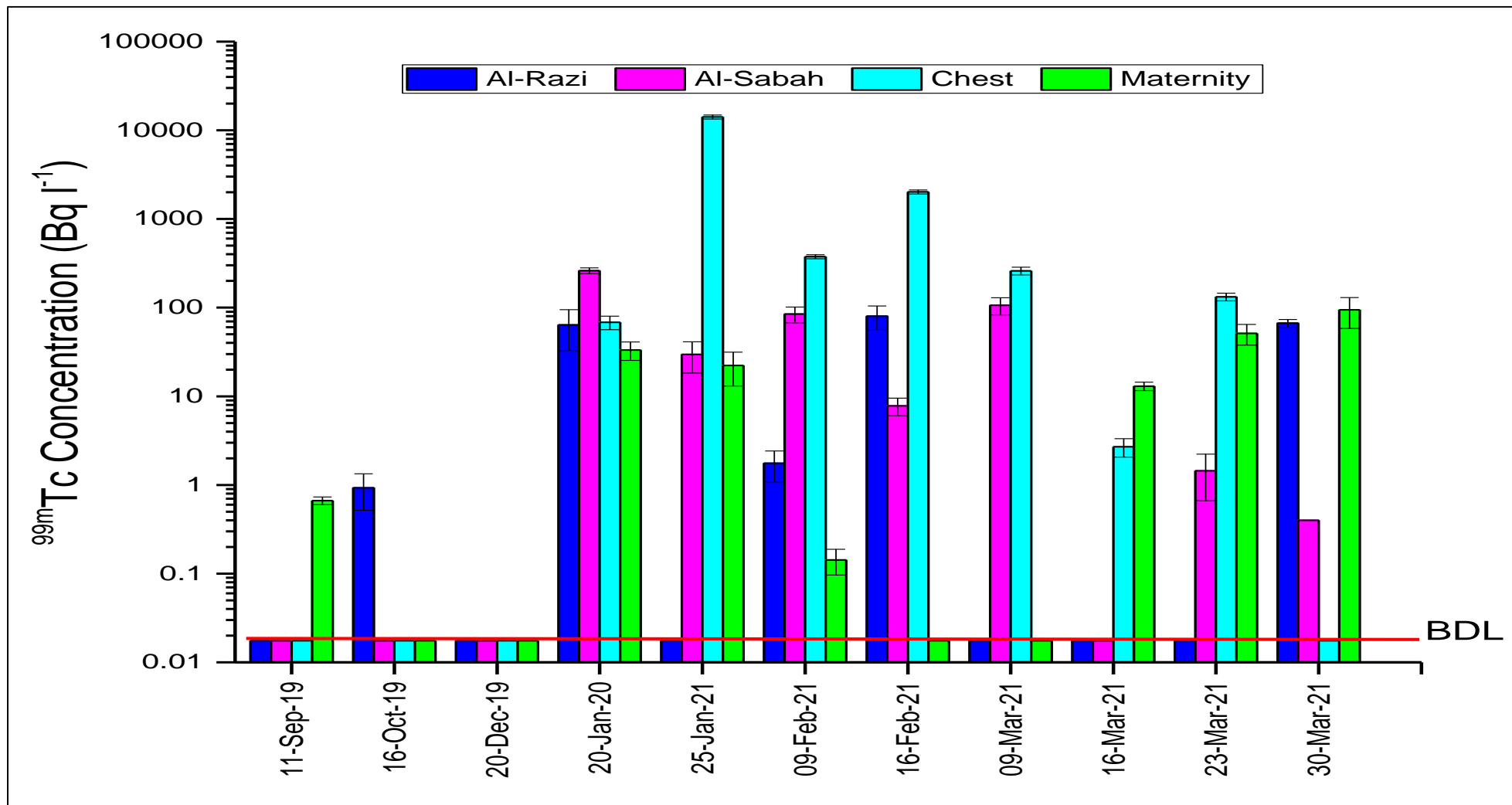
# Gamma spectrum generated by the Genie-2000 software using the HPGe detector



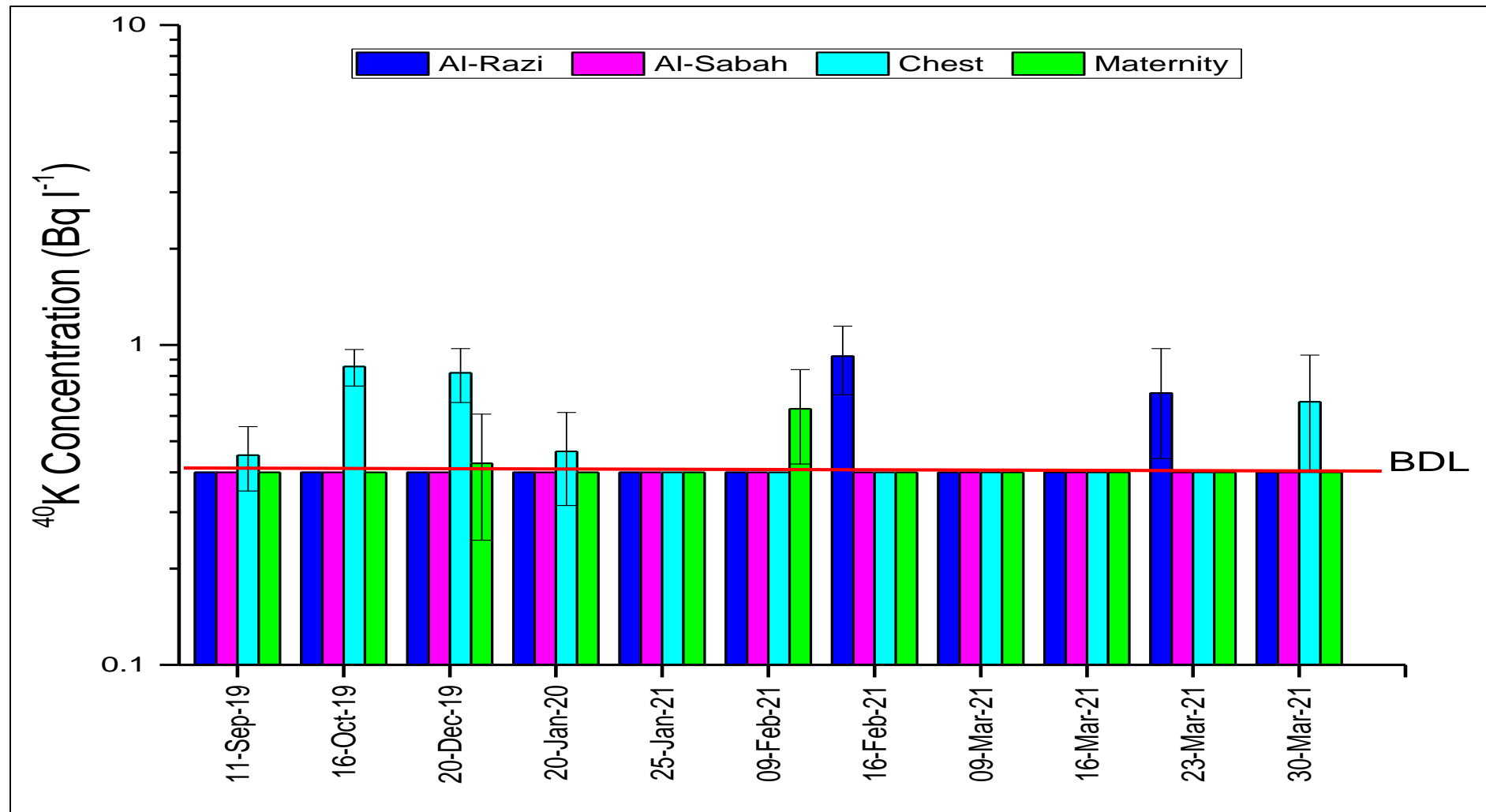
# $^{131}\text{I}$ activity concentration in wastewater from all studied hospitals in Kuwait.



# $^{99m}\text{Tc}$ activity concentration in wastewater from all studied hospitals in Kuwait



# $^{40}\text{K}$ activity concentration in wastewater from all studied hospitals in Kuwait



# Mean concentrations of pharmaceuticals in wastewater from four hospitals in Kuwait

Serial No.	Name of pharmaceuticals	HOSPITAL Names			
		Al-Sabah	Al-Razi	Maternity	Chest
1	Metronidazol ( $\mu\text{g/l}$ )	10.12	0.403	<b>45.8</b>	0.159
2	Paracetamol ( $\mu\text{g/l}$ )	<b>141.6</b>	179.2	66.55	49.04
3	Ranitidine ( $\mu\text{g/l}$ )	<b>0.26</b>	0.05	0.07	0.10
4	Sulfamethoxazol ( $\mu\text{g/l}$ )	0.42	<b>0.71</b>	0.06	0.03
5		0.08	<b>0.11</b>	0.02	0.01



## Conclusions

- $^{99m}\text{Tc}$  radionuclide, which is extensively used for diagnosis has been found as a common radionuclide used in the four discharging points; while  $^{131}\text{I}$  was found only in Al-Razi and Al-Sabah hospitals. The natural radionuclide  $^{40}\text{K}$  was found in all samples within the natural background level.
- Five pharmaceuticals including Metronidazole, Trimethoprim, Sulphamethoxazole, Paracetamol and Ranitidine were detected in wastewater and it was found that the maximum concentration among them appeared for Paracetamol.

# Recommendations

- Yearly wastewater monitoring program should be established for all hospitals. The wastewater sampling campaign should cover full analysis of physical, chemical, organics, microbial, radioactive isotopes, toxicity, human hormones and pharmaceutical compounds. In addition, onsite field measurements should be conducted prior to sampling. Automatic online sampling equipment should be implemented to obtain fully representative samples.
- Onsite treatment units should be constructed within each hospital premises to treat and if possible reuse of generated wastewater. The capacity of treatment units should be designed based on the volume of wastewater generated by each hospital daily.
- Onsite treatment unit should consist of the following stages: preliminary treatment, extended aeration, membrane bioreactor, ozone oxidation for permeate disinfection by UV and excess sludge utilization.

# Acknowledgements

- Continuous support from Top Management of Kuwait Institute for Scientific Research (KISR) and Kuwait Foundation for the Advancement of Science (KFAS) is highly appreciated for funding the study.
- Thanks extends to Water Research Center staff at KISR.