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Evaluation of fluoride levels in the ground water wells in the Western part of Jifarah plain area, Libya.

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ABSTRACT: *Fluoride plays a key role in the human body if it presents between 0.8 and 1.5 mg /l in drinking water. However, if the concentration is higher than that, it causes dental and skeletal fluorosis. The current study aims at investigating the fluoride levels of ground water wells on the Western part of Jifarah plain area as a representative to be a base line for subsequent studies and criteria for the public health. Thirty ground water samples were collected in October 2022 and were analyzed for fluoride. The results showed that the concentrations of fluoride ranged between 0.05 and 3.27 mg / l with an average of 1.58mg /l. The results also showed that a round 40 % of the sampling sites had high levels of fluoride. The levels crossed the limit recommended by the world health organization and the Libyan Standard and specification center. This study revealed that the high values of fluoride are probably due to the seawater intrusion with the ground water in the study area or the intensive application of the chemical fertilizers in the agriculture. It`s also revealed that the most of the ground water wells are suitable and can be used for drinking purposes. The remains should be treated to minimize the fluoride levels. People in the study area have to be educated environmental awareness on the health and water quality. Frequent analysis should be carried out to monitor the levels of fluoride in the ground water in the study area.*

KEYWORDS - *fertilizers, fluoride, groundwater, Libya, Jifarah plain area*

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I. INTRODUCTION

Fluoride is considered one of the most dominant elements in the environment. It is found naturally in groundwater in different parts of the world. This element is an electronegative and never found in the nature in elemental form. It combines with several chemical elements to form other fluorides. The sources of fluoride in ground water are igneous and sedimentary rocks; fluorspars, cryolite and fluoroapatite are considered the most common fluoride bearing minerals. Fluorite is the main bearer of fluoride and is found in granite and pegmatite [1, 2, 3, and 4].Anthropogenic activities such as burning of coal, manufacturing of aluminum, steel and phosphate fertilizers contain significant a mounts of fluoride [1, 5]. Some chemical fertilizers considered very important source of fluoride contamination to the soils [6, 7, 8, and 9]. [10] Reported that the agrochemicals could be transported towards the groundwater. While, the pesticides contain fluoride and effect the agricultural soils [11].

Fluoride first detected in ground water in Nellore district of Andhra Pradesh, India (12]. According, to [13] the first reports about the occurrence of mottled enamel in South Africa were in 1935 and 1938. Fluoride plays a key role in the growth of the teeth and reduces the dental caries when it presents in optimum concentrations, high or low levels in the drinking water cause dental and skeletal fluorosis [14] about 96 % of the fluoride is found in the bones and teeth. Fluoride also plays a vital role in the mineralization of the bones and formation of the dental enamel [15]. Fluoride in drinking water has become one of the most health problems worldwide, as more than 200 million people from different Countries are subject to dental and skeletal fluorosis. Many countries such as, China, India, Sir Lanka, Mexico, Argentina, and many countries in Africa have very high rates of dental and skeletal fluorosis caused by high levels of fluoride in drinking water [16, 17].

Fluorosis is widespread in many developed and developing countries [18]. Fluorosis was reported in 13 of the Indian states, in 1992 it was 15, in 2002 became 17 and now the effected states exceed to 19, indicating that the fluorosis is the most serious problem around the Country. [19] reported that about 62 million of people of which 6 million children are suffering from the disease because of consuming drinking water with high fluoride content. According to [20, 21] the recommended limit of fluoride in drinking water should not exceed 1.5 mg / l. The permissible value of fluoride in drinking water should be between 0.8 and 1.5 mg / l.

[22] Found that the levels of fluoride in ground water of North Jordan ranged between 0.009 and 0.005 mg / l. [23] Carried out a study to investigate the fluoride levels of Quaternary ground water aquifer at Luxor area, Egypt, and found that the fluoride was between 0.113 and 0.452 with an average of 0.242 mg / l. [24] assessed the fluoride level in AmasBlock of Gaga district, Bihar India, indicated that the fluoride limits were between 0.2

and 5 mg / l. The levels of fluoride in ground water of the South east of Algeria varied from 0.75 to 3.22 mg / l [25].

Similarly, [26] conducted a research to investigate the levels of fluoride in ground water in some parts in the North West of Nigeria and found that the concentrations ranged between 0.10 and 3.16 mg / l in the dry season. They also found that its levels in the wet season were between 0.10 and 1.47 mg / l. While, the values of fluoride in ground water of Maku area, North West of Iran stretched from 0.3 to 5.96 mg / l [27]. Fluoride levels in subsurface water in the Hidhran and Alburayhi basin, North West of Taiz, Yemen, was found between 1.08 and 10 mg / l with an average of 3.36 mg / l [28]. Likewise, [29] collected ground water sample to assess the water quality in the agricultural zone of Sidi Abdelrrazak, Morocco. They found that the concentration of fluoride ranged between 0.27 and 0.71 mg / l. [30] reported that fluoride levels in ground water Kolar and Tumkur Districts of Karnataka, India, varied between 0.36 and 3.34 mg / l. Fluoride values in ground water in Alagilat City, Libya, crossed the recommended limit set by world health organization [31].

[32] reported that the fluoride concentrations in Hassi Messaoud area, Southern Algeria was between 0.4 and 2.93 mg / l with an average of 2.1 mg / l. whereas, [33] reported that the fluoride level in the ground water in Gabes – South deep aquifer, South- eastern Tunisia crossed the limit set by world health organization. While, the mean value of fluoride in ground water in some Cities in Pakistan exceeds the limit set by world health organization (1.5 mg/l) [34]. The relation between the fluoride concentrations in ground water the schooling performances is an inverse [36].

II. METHOGOLOGY

Jifarah plain area located between latitude 32° 30` and longitude 12° 30`, Northwest of Libya. It cover an area of 20000km2 and heavily populated along the coast. The area bounded on the north by the Mediterranean Sea coast; on the south by Nafusa, mountain .It also shares an international boundary with Tunisia to the west "Fig1". The area topographically is a low lying; its topography rises slowly from the sea level along the coast to 200 m at the foot of the escarpment of Nefusa Mountain. The maximum temperature is about 45°C and minimum 20°Cwith an average annual rainfall varies between 300 and 100mm. It has a dry climate with hot summer and cold winter. The main aquifers, which play a major role in the ground water flow in the Jifarah plain are the Upper Miocene, Pliocene and Quaternary, the Middle and lower Miocene, and Triassic formation [35]. Groundwater considered the main source of water supply in the area. The dominant soils are sandy, clay and salty soils. Economically, Jifarah plain is considered one of the most important plains in Libya, the described area is known as an urban and rural area that the society mostly depends on its land resource for the human consumption. A round 60% of the irrigated areas situated in this region. The agriculture considered one of the most important activities in the area where barley, wheat, peanuts, vegetables and fodder crops are grown.

No comprehensive studies have been done in the Jifarah plain area. The current study aims at investigating the fluoride levels of ground water wells at Jifarah plain area as a representative region to be a base line for subsequent studies and criteria for the public health. The points of the sample collection equally distributed between three sites of Jifarah plain area namely, in the mountain of Nafusa, at the foot of the mountain, and the Coastal plain.

The Global-positioning system (Garmin`s GPS map 76CSx) was used to locate the ground water wells. Thirty ground water samples were collected in October 2022 from the Cities, and the towns that are located on those sites. The samples were collected from public wells, private wells, water sources in the health centers, and schools. First, the water was left to run for few minutes from the wells to pump out the standing water before taking the final samples. The samples were collected in pre cleaned sterilized polyethylene plastic bottles of 1L capacity then the samples were placed in clean containers and immediately put in ice boxes. The iceboxes were transported to Tripoli, where the analyses of fluoride were done by DR 3800 SC VIS Spectrophotometer technique in the laboratories of Sadeem Company for laboratories technology. Software such as, Excel 2013 and sigma plot v 10 were used for the analysis of the Data and visualization of the results. The concentrations of fluoride expressed in mg L -1 and the results were compared with the standard recommended by world health organization and Libyan standard and specification [20, 21] for fluoride concentrations.

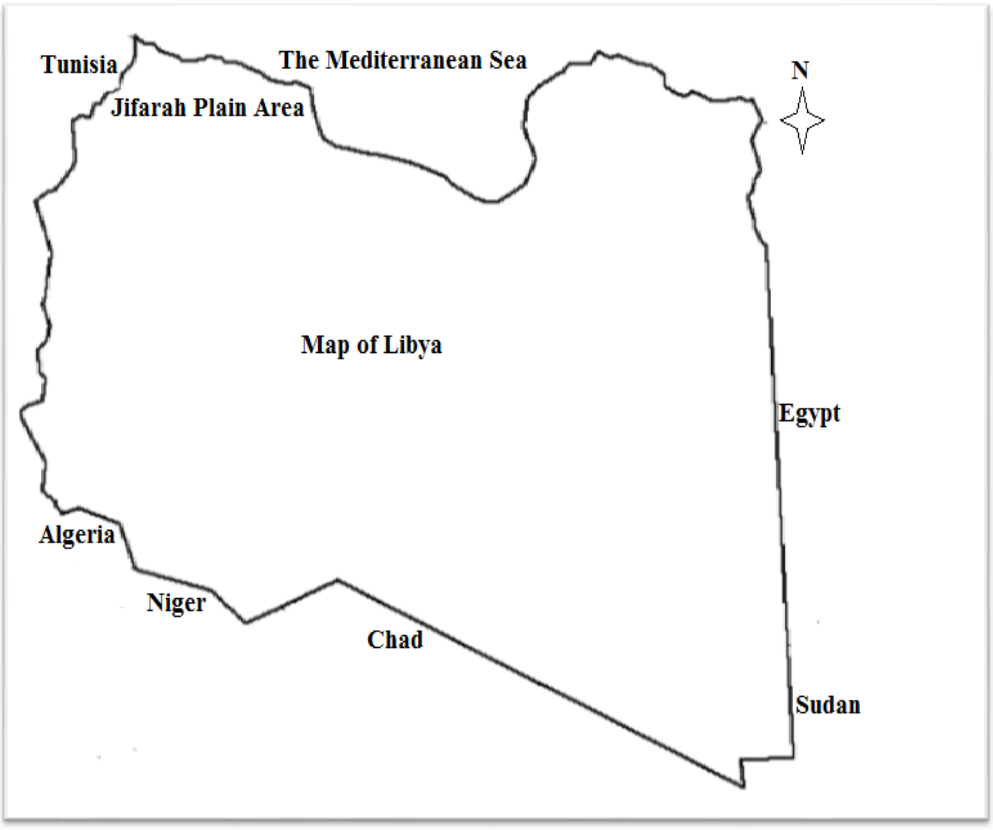
III. RESULTS AND DISSCUTION

The results of fluoride analysis in the ground water samples of Jifarah plain area are displayed in "Fig2". The values of fluoride in the samples varied between 0.05 and 3.27 mg /l with an average of 1.58 mg /l. The lowest concentration was measured in the Town of Badr. Whereas, the highest one was noticed in the Town of Rigdaleen. The detailed results are illustrated in" Fig3" and "Table1". Fluoride concentrations in the ground water samples that were collected from the Cities and Towns located on the Coastal plain ranged between 1.34 and 3.27 mg / l with an average of 2.43 mg / l. The highest value of fluoride was noticed in the City of Rigdaleen and the lowest value was measured in Bir benshaab. The results from the ground water samples collected from the Cities and Towns at the foot of Nafusa Mountain showed fluoride levels less than the levels that measured in Coastal plain

area. Where, the concentrations of fluoride ranged from 0.05 to 2.31 mg / l with an average of 1.20 mg / l. The lowest value was observed in the Town of Badr and the highest one was recorded in the village of Wadi alhii. Whereas, the Cities and the Towns that located in Nafusa Mountain showed the lowest levels of fluoride in the ground water of the study area. Where, the values of fluoride were between 0.51 and 2.38 mg / l with an average of 1.10 mg / l. The lowest and the highest values were noticed in the ground water samples collected from Towns of Alasabaa and Kabaw respectively. The concentrations of fluoride that measured in the current study were higher than the levels found by [32] but they were less than the fluoride levels obtained by [24].

As can be seen from the displayed results fluoride concentration in the samples collected from the ground water wells in the coastal plain were higher than those samples collected from the wells located on the South of Jifarah plain area. The high levels of fluoride are probably due the effect of the agricultural activities such as, fertilizers application and the effect of the seawater intrusion with the ground water or due to the geological formation in the study area. The results revealed this alarming level of fluoride in the study area. The results also revealed that 60 % of the taken samples were found within the permissible limit recommended by the world health organization and the Libyan standard and specification. Whereas, 40 % of the samples had fluoride, levels higher than the permissible limit (1.5 mg /l). Fluorosis phenomenon was seen in those areas in which fluoride concentrations were higher than the recommended guidelines for drinking water. That reflects the high concentrations of fluoride in the ground water wells in the study area. "Fig4" shows some photocopies of the people who are suffering of the disease.

IV. FIGURES AND TABLES



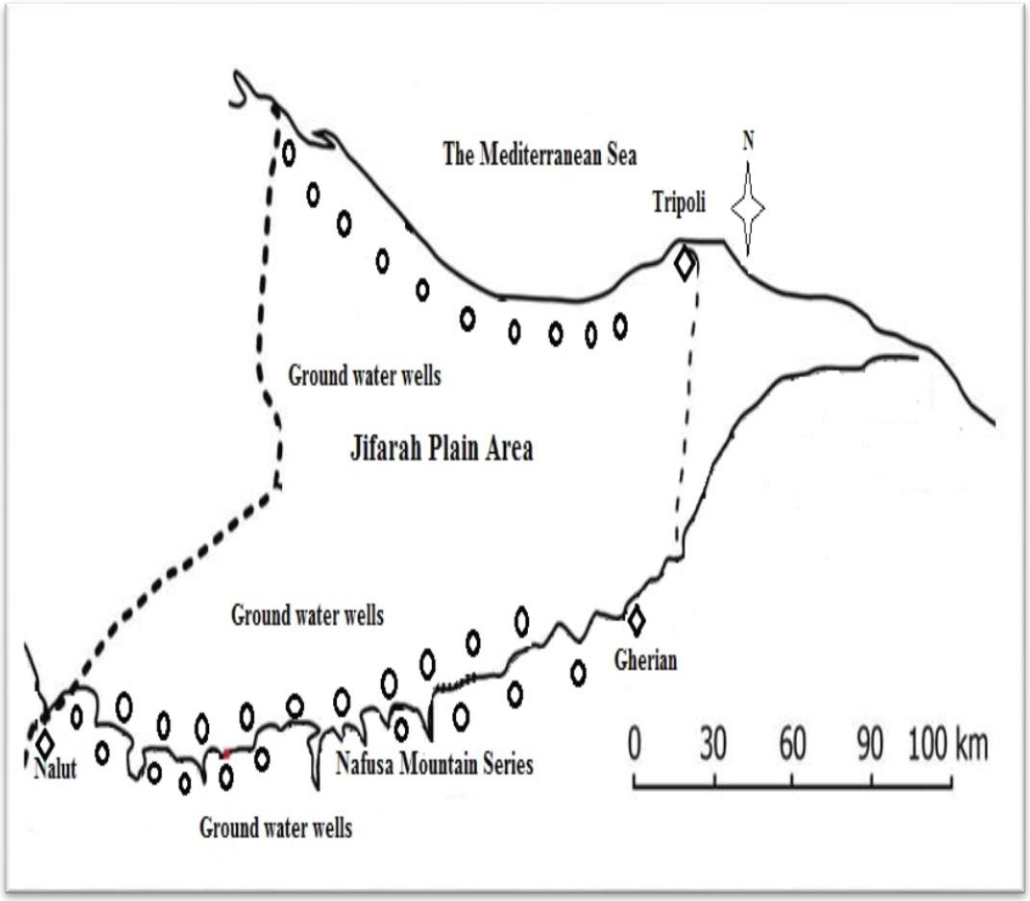


Fig 1. Map of Libya showing the study area (Jifarah plain area)

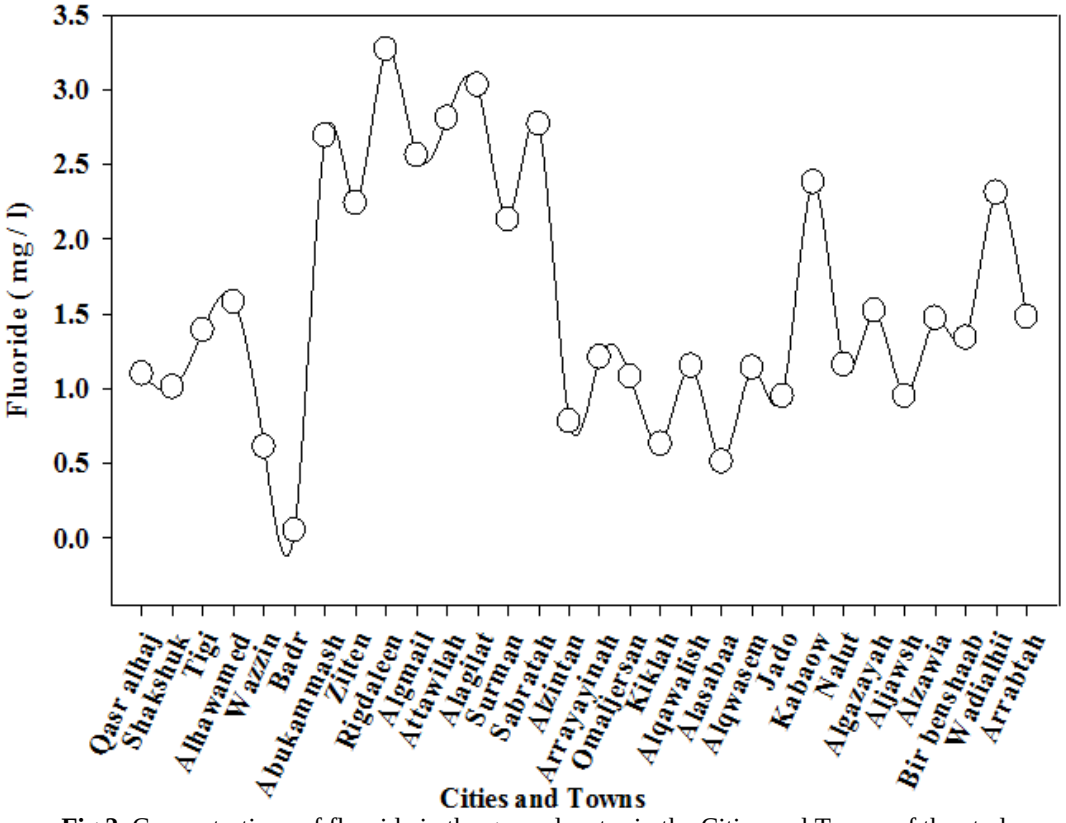


Fig 2. Concentrations of fluoride in the ground water in the Cities and Towns of the study area

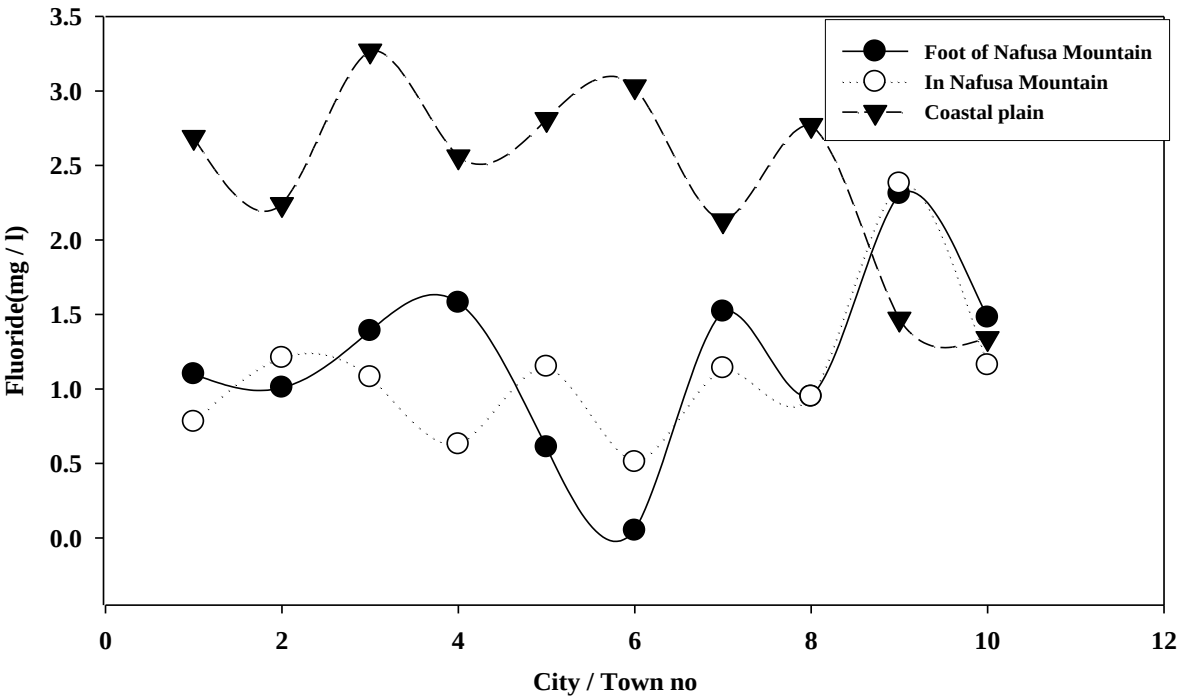


Fig 3. Concentration of fluoride in the ground water in different sites of the study area

Fig 4. Fluorosis phenomenon in the study area (photographed by Hnaish, Dentist)

Table 1. Concentrations of fluoride (mg / l) in the ground water wells of Jifarah plain area

Coastal plain		Foot of Nafusa Mountain		In Nafusa Mountain	
City / Town	Concentration	City / Town	Concentration	City / Town	Concentration
Abukammash	2.69	Qasr alhaj	1.10	Alzintan	0.78
Zilten	2.24	Shakshuk	1.01	Arrayayinah	1.21
Rigdaleen	3.27	Tigi	1.39	Omaljersan	1.08
Algmail	2.56	Alhawamid	1.58	Kiklah	0.63
Attawelah	2.81	Wazzin	0.61	Alqawalish	1.15
Alagilat	3.03	Badr	0.05	Alasabaa	0.51
Surman	2.13	Alagazayah	1.52	Alqwasim	1.14
Sabratah	2.77	Aljawsh	0.95	Jado	0.95
Zawia	1.47	Wadi alhii	2.31	Kabaw	2.38
Bir benshaab	1.34	Arrabtah	1.48	Nalut	1.16
Mean	**2.43**	**Mean**	**1.20**	**Mean**	**1.10**

V .CONCLUSION AND RECOMMENDATIONS

On the bases of the current findings, we conclude that 60 % of the studied ground water wells were within the permissible limit (1.5mg / l) set by the world health organization and the Libyan standard and specifications. Whereas, 40 % of the samples crossed the recommended one and is not safe for drinking purposes. We also conclude that fluoride levels in the ground water samples, which collected from the wells on the coastal plain, were higher than the fluoride values in the samples, which, collected from the South of the Jifarah plain. The contaminated wells are probably due to the seawater intrusion or to the application of chemical fertilizers. We recommend that the contaminated wells should undergo to the treatment to reduce the fluoride levels, and the residents have to be educated environmental awareness on the health and water quality. We also recommend that frequent analysis should be carried out to monitor the levels of fluoride in the ground water wells in the study area.

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