DISTRIBUTION AND TREATMENT OF FLUORIDE ANIONS IN DRINKING WATER OF ALGERIAN TOWNS: (BATNA–BISKRA–EL-OUED)

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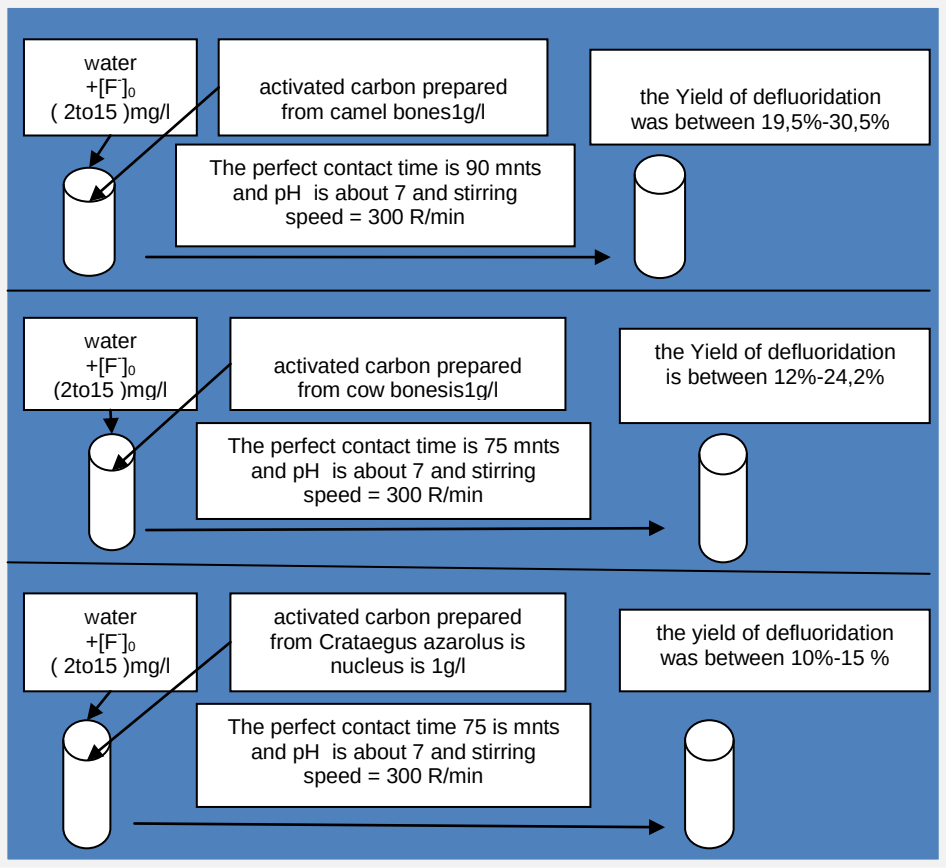
ABSTRACT

In this work, we conducted tests for about 73 samples. We have focused on fluoride anions in the drinking water of Biskra,Batna, and El-Oued Towns. We found that most of the drinking water of Biskra and El_Oued contains excessive concentrations of fluoride (more than 1,5mg/l). In order to reduce the concentration of fluoride, we have used adsorption of fluoride from drinking water samples by activated carbon prepared from: camel bones with a yield between 19,5%-30,5%;cow bones with a yield between 12%-24,2% and Crataegus azarolus nucleus with a yield between 15%-10 %. The former yields were found when the concentration of fluoride increases from 2mg/l to 15 mg/l. We also found that the ideal concentration of activated carbon of the three types is 1g/l; the contact time for the treatment by activated carbon prepared from cow bones is 90minutes. As for the time contact of activated carbon prepared from camel bones and from Crataegus azarolus nucleus, it was more than 75 minutes. For the steering speed, when it increases, the concentration of fluoride decreases. The ideal pH is about 7.The majority of drinking water of the state of Batna contains a low concentration of Fluoride lower than 0.5mg/l. they must compensate this deficiency from Foods like dates and fish.

GRAPHICAL



KEYWORDS: Fluorosis, Fluoride, adsorption,activated carbon.

1 INTRODUCTION

Natural drinking water contains several metals and elements including fluoride anions that cause dental fluorosis. Fluorosis only appears with high fluoride consumption[01]. The ideal fluoride quantity which should be consumed is related to environment temperature and the type of food consumed in abundance [02]. It is also related to person's age [03,04]. Dental Fluorosis is widespread in many countries such as Tanzania[05], Sudan ,Eritrea, Mozambique ,Uganda[06], Malawi [07],Kenya [08] China [09], and Southern India [10,11] where 25 million people are infected among which one million are infected with bone fluorosis [12].Fluorosis is an epidemic in Mexico [13] where the estimated number of infected people is 05 millions.

Algeria is among the countries that suffer from fluorosis in its south[14,15].The lack of fluoride contributes to tooth decay [16].In light of these facts, several studies were conducted to reduce the concentration of fluoride anions in drinking water using membranes [17,18] and alumunium sulfate and activated alumina[19,20]. We have treated fluoride-polluted water in several areas of Algeria (Batna,Biskra, El_oued) with diversity of water sources using the activated carbon prepared from cow bones , camel bones and Crataegus azarolus nucleus with some factors affecting the treatment .

2 EXPERIMENTAL PROCEDURE

2.1 Determination of the amount of fluoride in the samples

In order to determine the amount of fluoride in the samples using potentiometric method . We have created the measurement curve. So we first prepared a solution of (NaF) which will be used in the preparation of standard solution accurately. Then we measure fluoride concentration using a specific electrode of fluoride applying potentiometric method[21]According to the obtained results, we drew a measurement curve to determine the amount of fluoride in each step.

2.2 Samples

In order to know the concentration of fluoride in drinking water of the states of Batna, Biskra and El-oued, we took samples of water sources, and we determined the amount of fluoride in each of them by studying some water physical and chemical properties. We studied the samples in the laboratory under certain conditions as follows :

1. The water tap was opened for approximately 03 minutes to drain stuck objects.
2. Samples were taken in plastic bottles (of polyethylene 1,5 liters).These bottles were washed with the water of the samples several times then filled with water and closed tightly to avoid air. the bottles were kept at room temperature for less than 48 hours .
3. The obtained results are shown in table (1) (2) and (3)

3 RESULTS AND DISCUSSION OF WATER ANALYSIS

3.1 Results of water analysis

Table 01: the results of water Analysis in the state of El-oued

Place of sampling	pH	Cond. mS/cm	TAC F°	Ca^{2+} mg/l	Mg^{2+} mg/l	SO_4^{2-} mg/l	Cl^- mg/l	NO_3^- mg/l	F^- mg/l
Mouiha ouensa	7,23	4,76	13,9	296,59	157,98	400	699,23	5,1	**1,94**
Still	7,41	4,83	13,0	355,70	192,57	512	935,95	6,0	**2,13**
El Hamraia	7,26	3,44	12,8	316,63	150,69	510	836,69	4,9	**1,73**
Couininne	7,30	4,08	12,9	296,59	157,98	573	953,68	6,2	**2,07**
El Ogla	7,10	3,51	13,1	272,54	99,65	710	850,85	5,0	**2,03**
El Nakhla	7,43	3,46	13,1	256,51	99,65	304	801,23	9,4	**1,86**
Sidi kahlli	7,20	7,13	11,4	545,08	174,64	806	1264,21	8,4	**2,64**
Hassani Abd AlKarim 01	7,42	3,41	11,5	272,55	102,08	710	894,14	5,0	**2,20**
Sidi Mastour	7,57	3,44	12,7	392,78	149,28	533	801,23	5,8	**1.90**
Chouhada 01hot	7,03	2,17	14,1	368,75	97,22	973	617,99	1,8	**0,63**
Chouhada 02cold	7,28	4,34	13,1	312,62	155,54	544	829,60	5,9	**2,63**
Djamaa	7,24	2,76	15,0	204,40	126,38	620	404,16	1,5	**0,67**
Benguecha	7,80	5,66	11,6	360,72	149,28	559	893,41	4,1	**2,08**
El Magrane	7,39	3,45	12,7	392,78	60,76	442	758,69	5,8	**2,02**
Trifaoui	7,72	3,44	13,4	384,76	150,69	698	801,23	5,9	**0,62**

Ourmes	7,66	5,14	12,7	348,69	174,99	533	1006,8	8,1	**2,09**
Hassi Kahlifa02	7,83	3,58	13,3	384,76	97,22	712	794,14	7,1	**2,17**
El Meghaier	7,84	3,45	12,8	392,78	60,76	694	758,69	5,8	**2,05**
Hassani Abd AlKarim 02	7,41	3,50	11,4	296,59	109,37	533	893,16	6,3	**2,07**
Sidi Aoun	7,48	3,51	12,7	276,55	121,62	442	815,41	6,5	**2,10**
El Robah	7,61	3,47	13,1	264,53	109,37	468	815,42	4,9	**1,91**
Oued El Alenda	7,50	1,75	13,3	296,59	157,98	492	198,08	4,9	**1,89**
Debila	7,57	3,66	12,4	440,88	119,09	510	801,23	7,1	**2,25**
Quarter 08 May	7,20	3,46	13,0	296,59	211,45	573	794,14	4,9	**1,84**
Quarter 400 Residence	7,10	3,51	11,4	312,62	126,38	304	699,23	5,8	**1,92**
Quarter 01 Novembre	7,39	4,92	13,8	308,61	161,38	469	801,23	7,4	**1,94**
Quarter 19 Mars	7,26	4,08	11,5	312,62	97,22	512	935,95	5,0	**1,87**
Hassi Kahlifa01	7,83	3,58	13,3	384,76	97,22	712	794,14	7,1	**2,17**
Tindla	7,49	2,74	14,2	236,47	143,39	530	389,98	1,7	**0,62**
Sidi Amran	7,51	2,77	16,3	252,50	104,51	570	397,03	1,8	**0,85**
Guemmar01	7,39	4,92	13,8	308,61	211,45	585	872,14	6,1	**2,19**
El Bayada	7,73	3,46	12,7	268,54	94,78	469	815,41	7,4	**2,01**
Guemmar02	7,39	4,92	13,8	308,61	211,45	585	872,14	6,1	**2,19**
Reguiba	7,94	4,85	13,0	308,10	161,38	572	815,41	6,3	**2,04**

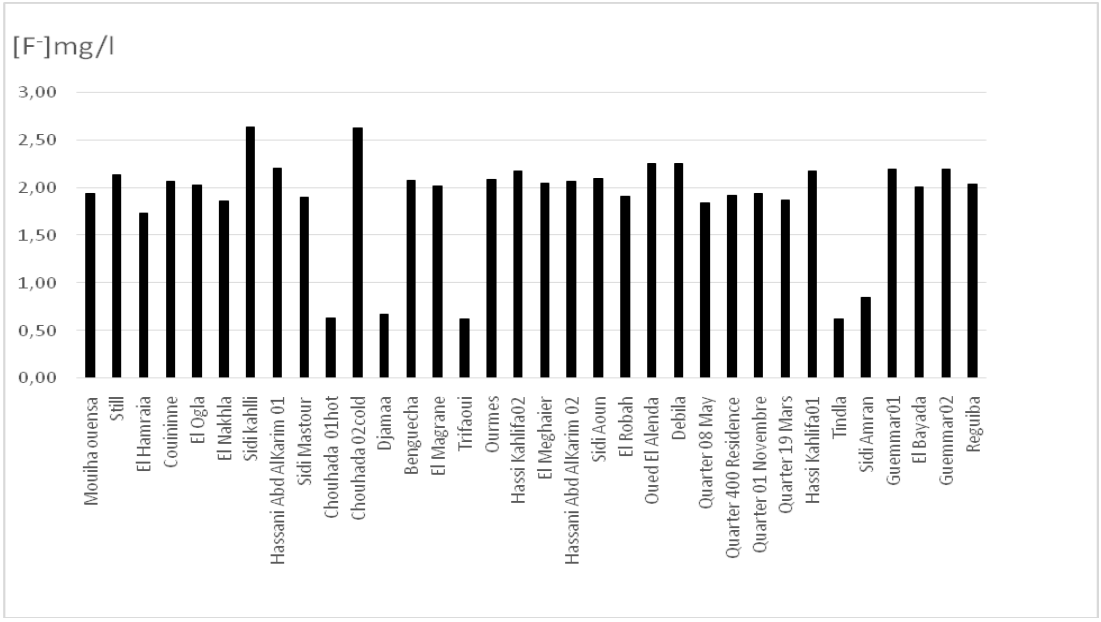


Figure 01: Histogram of fluoride ions concentration in the state of El-oued

Table 02: the results of water Analysis in the state of Biskra

Place of sampling	**pH**	**Cond. mS/cm**	**TAC F°**	**Ca^{2+} mg/l**	**Mg^{2+} mg/l**	**SO_4^{2-} mg/l**	**Cl^- mg/l**	**NO_3^- mg/l**	**F^- mg/l**
Ourlale	7,38	2,60	12,6	952,3	172,4	312	444	14,3	**1,42**
Bear Naame	7,14	3,02	13,1	855,1	200,3	285	385	9,5	**0,65**
El Doussen	7,25	2,89	12,8	620,5	141,3	1562	652	4,6	**1,89**
Sidi Khaled	7,45	3,61	13,4	752,3	188,6	435	356	5,6	**1,03**
Mechounche	7,23	3,54	12,5	844,5	198,2	561	384	6,2	**0,95**
Sidi Oukba Wells Guirta	7,28	4,32	14,31	319,8	150,2	243	835	2,4	**1,25**
Sidi Oukba Wells complexe	7,29	4,34	14,01	280,1	119,8	205	901	5,9	**1,26**
Tolgua Wells khnizan	7,19	3,85	12,65	365,1	104,9	68	575	4,2	**1,38**
Tolgua Wells farfar	7,35	2,62	13,41	358.2	103,4	69	257	5,4	**1,53**
Réservoir Mokhaime	7,16	3,16	13,20	374,6	128,5	354	845	4,6	**1,46**
Guentra	7,65	4,11	14,11	456,3	101,4	356	756	4,9	**1,02**
Djamoura	7,15	3,25	12,61	458	118,6	365	755	5,1	**0,95**
Biskra Wells	7,05	4,55	14,51	323,9	68,4	190,6	710,5	4,4	**1,10**

Rasse El guerya									
Biskra Wells 01 November	7,32	4,41	14,62	280,9	120,8	199,5	908,6	5,6	**1,33**
Biskra Wells faliashe	7,11	4,76	15,10	247,9	116,8	111,5	981,1	5,4	**1,01**
Biskra el Alya	7,22	4,26	15,21	220,1	114,4	80,2	894,6	4,6	**0,90**
Biskra El Hajeb	7,22	3,87	12,51	261,2	123,3	140,2	701,5	3,2	**0,91**
Biskra Réservoir choucha	7,02	3,12	13,14	254,6	112,6	121,5	701,2	4,5	**1,75**
Biskra Wells Magueloube	7,04	4,15	13,26	325,2	79,5	115,6	845,6	5 ;1	**1,62**
Biskra Quarter Mojahidine	7,21	3,45	13,25	211,2	89,4	102,3	677,3	3,6	**0,89**
Biskra Wells ouade elhay réservoir rodary	7,35	3,64	13,11	204,6	99,1	141,2	771	4,1	**1,10**

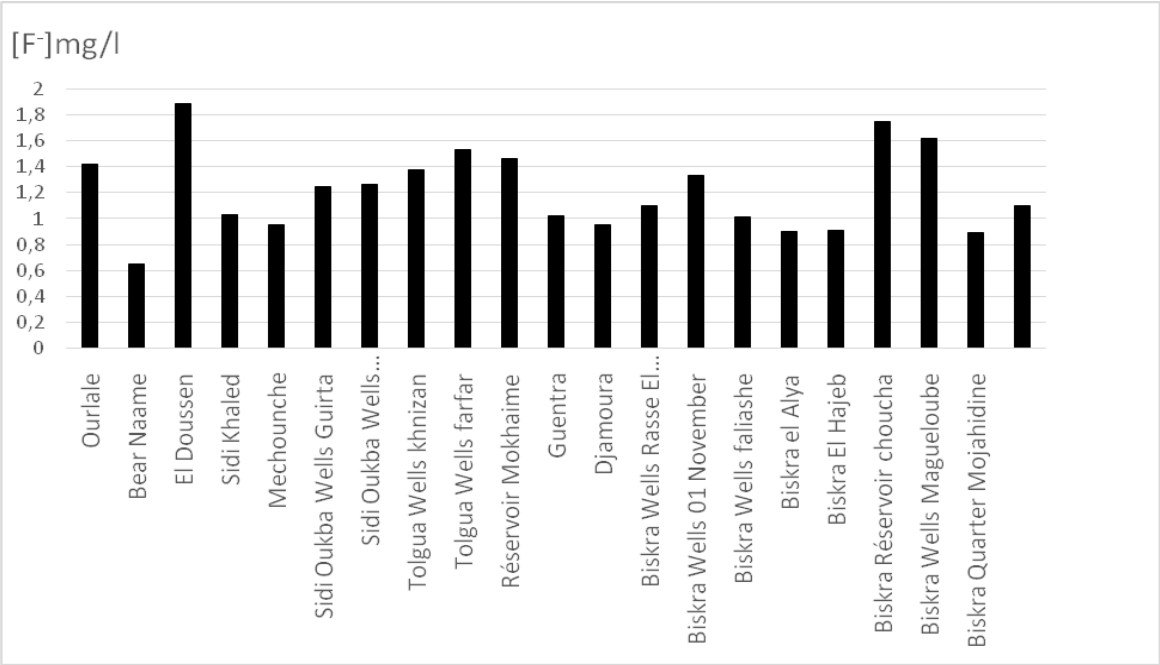


Figure 02: Histogram of fluoride ions concentration in the state of Biskra

Table 03: the results of water Analysis in the state of Batna

Place of sampling	**pH**	**Cond. mS/cm**	**TAC F°**	**Ca^{2+} mg/l**	**Mg^{2+} mg/l**	**SO_4^{2-} mg/l**	**Cl^- mg/l**	**NO_3^- mg/l**	**F^- mg/l**
Batna Wells kchida ParKing municipal	7,33	2,45	12,11	301,2	100,5	71,3	120,6	6,5	**0,42**
Batna Wells K3	7,23	2,54	15,11	93,2	41,3	87,9	72,3	6,34	**0,30**
Batna Wells K4	7,62	2,65	16,22	78,54	33,04	42,5	45,62	7,65	**0 ,37**
Batna Wells azaabe	7,12	1,89	12,04	130,8	90,9	84,3	470,14	17,2	**0,37**
Wells 102	7,65	1,45	12,45	281,6	120,4	237,3	331,1	70,1	**0,49**
Wells Quarter Riadh	7,85	1,69	11,56	80,5	40,1	37,5	161,4	6,2	**0,30**
Réservoir Parkafourage	7,47	0,95	11,68	190,3	89,2	65,2	102,7	5,4	**0,29**
Tazoult (head	7,36	2,36	11,87	151,2	77,3	152,3	66,41	0,8	**0,15**

Water dardour)									
Tazoult Wells chnatif mosque Nour	7,25	2,36	11,25	147,2	75,3	161,4	69,1	3,2	**0,17**
Timgad Wells sidi Maansar	7,32	2,99	12,04	185,2	90,1	102,7	75,1	5,1	**0,50**
Timgad head water in mory	7,11	1,89	12,07	200,5	101,3	100,1	65,7	4,3	**0,20**
Wells ouelad Fadhel	7,22	1,99	11,36	208,4	149,41	154	77,6	2,1	**0,47**
Batna Wells mosque Neouaoura (Road hamla)	7,41	1,47	11,78	245,4	150 ,9	165 ,2	81,5	3,6	**0,24**
Fisdisse	7,37	1,65	11,17	205,4	54,6	98,4	80 ,7	6,4	**0,38**
Merouana Réservoir Ali nemar	7,39	1,79	11,25	195,7	75,1	89,1	75,1	7,6	**0,28**
Wells zanna Baydha	7,71	2,10	11,69	201,3	89,4	97,7	80,8	4,3	**0,46**
Seriana Wells Tikousse	7,19	2,65	11,02	205,1	95,4	100,2	95,7	6,7	**0,33**
Boulhilatte (Wells Kouachia)	7,46	1,95	12,65	214	100,7	98,4	87,6	7,8	**0,34**

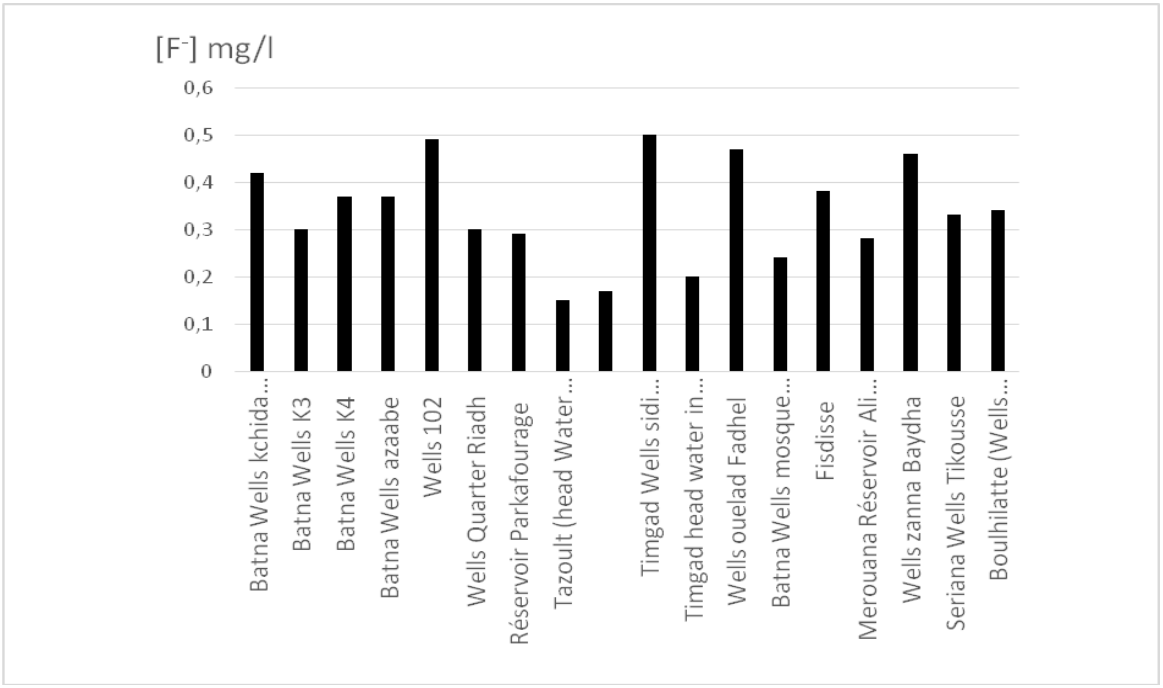


Figure 03: Histogram of fluoride ions concentration in the state of Batna

3.2 Interpretation of the results of water analysis

We note that the water in Batna contains amounts of Fluoride less than calibrated by world health organization, so residents of this state are advised to consume food containing fluoride such date and fish. They also can use fluoridated tooth paste[22] but most of Biskra and El_Oued areas contain amounts of Fluoride more than

calibrated by world health organization. This explains the emergence of fluorosis disease in those two states. Thus, water needs to be treated from fluoride pollution.

4 RESULTS AND INTERPRETATION OF WATER TREATMENT

4.1 Water treatment from fluoropolution using the activated carbon

The Activated carbon has been prepared in previous experiences from severals sources including coconut shells [23], almond shells [24].In our work we prepare 03 types of activated carbon from cow bones, camel bones ,Crataegus azarolus nucleus with the study of some factors affecting the treatment.

4.2 Preparation of activated carbon

-We Prepared 03 types of activated carbon from 02 types of bones: bones of camels and cows. The third was prepared from the nucleus of Crataegus azarolus.

-We took the initial samples and washed them very well with tap water to remove all impurities, then we washed them again carefully with distilled water.

-We drained the previous samples in oven for 24 hours at a temperature 105°c.After that, we grind the samples and sift them. The selected diameter was between 0.50, 1.5 cm.

- Then we started the chemical treatment of obtained berry before carbonization by treating the selected samples individually with acid ($HNO_3$10% , or H_3PO_4or H_2SO_4 Centre with water1/1).We used sulfuric acid H_2SO_4 in our experiment. We put the samples in an oven for 24 hours at a temperature of 103°c, then we keep them in closed bottles (isolated from air).

-After the chemical treatment, we dried the samples for 24 hours and at a temperature of 107°c.

-We took the samples to the oven immediately, and we processed carbonization in a temperature of 580 °c for bones of camels , 550 °c for cow bones and 500°c for the Crataegus azarolus nucleus. Then we waited until it returns to regular temperature.

-After that, we washed the samples with hydrochloric acid, HCl 0.1M, in order to treat the dry residues from incineration process .

-The final step is washing the activated carbon with distilled water .With the excess of distilled water, washing process lasts for several days .Then, we drain the samples for at least 09 hours under a temperature 107°c. Then we cool it and store it in well closed bottles (in isolation from the air). Thus, we have prepared the granular activated carbon [25]

4.3 Characterization of prepared activated carbon

4.3.1 pH of activated carbon

The pH of the activated carbon was determined by immersing the sample 1 g in 100ml Distilled water and stirring for 1 hour and measured by pH meter.

4.3.2 The relative humidity

We put 5 g of activated carbon in a crucible weighs P1, then the sample is placed in an oven at 105 °C. for one hour. Then, it is allowed to cool in a desiccator for 30 minutes. After repeating it P2, the relation below makes it possible to obtain the relative humidity rate H (%)

$$H(\%) = (P1 - P2) \cdot 100/P1$$

4.3.3 The apparent density

The apparent density is the set of solid and pore fractions. It is determined by the method of the graduated cylinder. An empty test tube is weighed. Then it is filled with the solid up to 100 ml. After that, we re-examined. The following relation allows the determination of the apparent density D (%) [169]:

$$D\ (\%) = (P1\text{-}P0) / 100$$

P1: the weight of the filled test piece (g). P0: the weight of the empty test piece (g).

4.3.4 Results characterization of activated carbons

Activated Carbon	pH	H (%)	D (%)
camel Bones Activated Carbon	6.88	6.18	0.31
Cow Bones Activated Carbon	6.54	6.51	0.38
***Activated Carbon Of*Crataegus azarolusNucleus**	6.49	6.42	0.21

4.3.5 The effect of initial concentration of fluoride

-We have prepared 14 samples of fluoride solutions with 100ml volume each. The concentration range is between 2 to15mg/l. For each sample, we have added an amount of 01g of activated carbon prepared from camel bones. After steering, the mixture was left for 03 hours before filtration. The concentration of fluoride anions was then measured using a specific fluoride electrode (potentiometric method). The same steps were followed to treat the samples with activated carbon prepared from cow bones and Crataegus azarolus nucleus. Table 04 shows the obtained results:

***Table 05: The effect of Primary concentration of fluoride on** the treatment yield %*

The Number of Samples	The Primary Concentration Of Fluoride C_0 [F^-] (mg/l)	The remaining Concentration Of Fluoride [F^-] (mg/l) When treated by camel Bones Activated Carbon	The Treatment yield%When treated by camel Bones Activated Carbon	*The remaining Concentration Of Fluoride [F^-] (mg/l) When treated by Cow Bones Activated Carbon*	The treatment yield %*When Treated by Cow Bones Activated Carbon*	*The remaining Concentration Of Fluoride [F^-] (mg/l) When treated by Activated Carbon Of* Crataegus azarolus Nucleus	The treatment yield %When Treated by Activated Carbon Of Crataegus azarolus Nucleus
1	2	1.61	19.5	1.76	12	1.80	10
2	3	2.40	20	2.63	12.3	2.69	10.3
3	4	3.16	21	3.50	12.5	3.58	10.5
4	5	3.89	22.2	4.35	13	4.45	11
5	6	4.62	23	5.15	14.2	5.30	11.7
6	7	5.34	23.7	5.93	15.3	6.16	12
7	8	6.03	24.6	6.72	16	7	12.5
8	9	6.75	25	7.41	17.7	7.85	12.8
9	10	7.46	25.4	8.16	18.4	8.69	13.1
10	11	8.13	26.1	9.88	19.3	9.49	13.7
11	12	8.76	27	9.5	20.8	10.32	14
12	13	9.45	27.3	10.14	22	11.5	14.2
13	14	9.94	29	10.67	23.8	11.97	14.5
14	15	10.43	30.5	11.37	24.2	12.75	15

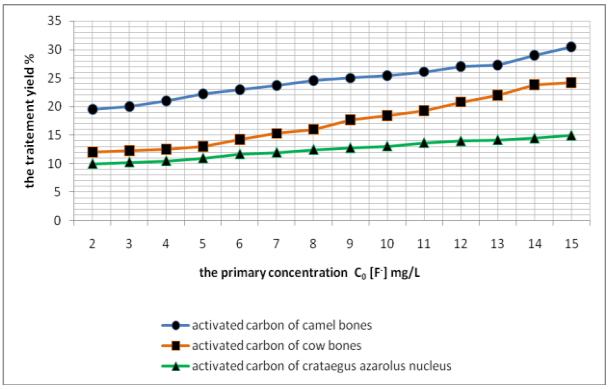


***Figure 04: The effect of Primary concentration of fluoride on** the treatment yield %*

We note that the percentage of fluoride elimination from water samples increases by about 11 % when the primary concentration of fluoride increases from 2mg/l to 15 mg/l for the treatment with camel bone activated carbon. It was 12 % for the treatment with cow bone activated carbon. For the treatment with the activated carbon prepared from Crataegus azarolus nucleus, it increases by about 05 %. This was explained by the increasing of fluoride primary concentration which lead to the increase of the contact with the specific surface of activated carbon.

We also found that the camel bone activated carbon is the best for the elimination of fluoride anions in water where the estimated treatment was more than 30%. It was 24 % for the cow bone activated carbon, and 15 %for the Crataegus azarolus nucleus activated carbon.

We explain the effectiveness of camel bone activated carbon by its specific surface of 321.425 g/m ². It is larger than the specific surface of cow bone activated (291.412 g/m ²) and greater than the specific surface of Crataegus azarolus nucleus activated carbon

nucleus (124.524g/m²). Larger specific surface lead to more adsorption

5.5.The effect of the activated carbon concentration

We prepare 06 samples of fluoride solutions .The volume of each one is 100 ml with the same concentration of 3mg/l, and we add different amounts of activated carbon from camel bones (0g-0.5g-1g-1.5g-2g-2.5g) respectively.

After stirring, we leave the samples for 3 hours. Then we filtrate and measure the concentration using a specific fluoride electrode (potentiometric electrode). The same steps were followed to study activated carbon prepared from cow bones and the one prepared from nucleus of Crataegus azarolus. The results were as follows:

Table 06: The effect of concentration of activated carbon on *the treatment yield %*

The Number of Samples	The Concentration Of Activated Carbon (g/l)	The remaining Concentration Of Fluoride [F⁻] (mg/l) When treated by camel bones activated carbon	The treatment yield % When treated by camel bones activated carbon	The remaining Concentration Of Fluoride [F⁻] (mg/l) When treated by cow bones activated carbon	The treatment yield % When Treated by Cow Bones activated carbon	The remaining Concentration of Fluoride [F⁻] (mg/l) When treated by Crataegus azarolus nucleus activated carbon	The yield Treatment % When treated byCrataegus azarolus nucleus activated carbon
1	0	3	0	3	0	3	0
2	5	2.60	13.33	2.8	6.66	2.86	4.66
3	10	2.40	20	2.63	12.33	2.69	10.30
4	15	2.30	23.33	2.50	16.66	2.58	14
5	20	2.25	25	2.40	20	2.45	18.33
6	25	2.21	26.33	2.35	21.66	2.40	20

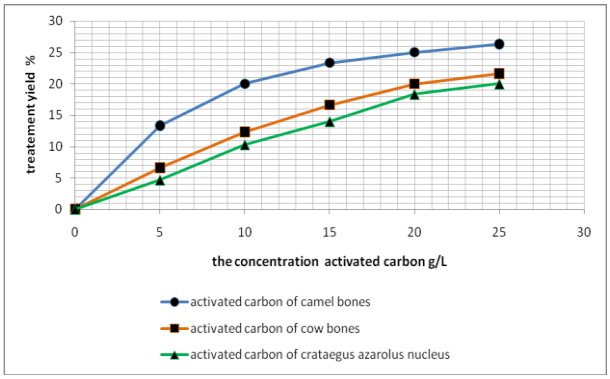


Figure 07: The effect of concentration of activated carbon on the treatment yield %

We note that the more the amount of activated carbon increases, the amount of treated fluoride increases .When the concentration of activated carbon increases from 5g/l to 25g/l, the yield of treatment increases in the three types of activated carbon .It is explained by an increase of the active sites of carbon, which adsorb fluoride anions leading to a decrease in the concentration of fluoride .The more the amount of activated carbon is, the bigger the specific surface becomes .Therefore, the active sites adsorb more fluoride anions.

4.4 The effect of contact time

We prepare samples of solutions of fluoride at temperature of 17°c and pH =6.71 .

The primary concentration of fluoride is 3 mg/l. The volume of samples is 100ml.

The amount of activated carbon is 1g.after stirring, we leave the samples for a while. The results are as follows:

Table 08: the effect of contact time

The Number of Samples	Contact Time (min)	The remaining Concentration Of Fluoride [F⁻] (mg/l) When treated by camel bones activated carbon	The treatment yield %When treated by camel bones activated carbon	The remaining Concentration Of Fluoride [F⁻] (mg/l) When treated by cow bones activated carbon	The treatment yield %When Treated by Cow Bones activated carbon	The remaining Concentration of Fluoride [F⁻] (mg/l) When treated byCrataegus azarolus nucleus activated carbon	The yield Treatment % When treated byCrataegus azarolus nucleus activated carbon
1	15	2.66	11.33	2.90	3.33	2.94	2
2	30	2.60	13.33	2.88	4	2.91	3
3	45	2.52	16	2.81	6.33	2.87	4.33
4	60	2.47	17.66	2.75	8.33	2.80	6.66
5	75	2.43	19	2.70	10	2.72	9.33
6	90	2.43	19	2.65	11.66	2.72	9.33
7	105	2.43	19	2.65	11.66	2.72	9.33
8	120	2.43	19	2.65	11.66	2.72	9.33

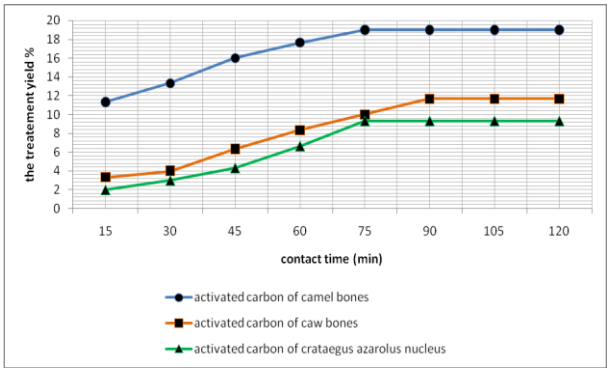


Figure 10: the effect of contact time on the treatment yield %

-We explain the rapid increase of adsorption at the beginning of contact time by the availability of so many vacant places ready for the adsorption of fluoride anions. Then, the process begins to slow down due to the saturation of the surface of activated carbon with fluoride anions. We also find that the ideal contact time of the treatment with activated carbon prepared from cow bones is more than 90min. For the treatment with the activated carbon prepared from camel bones and Crataegus azarolus nucleus was more than 75 minutes.

4.5 The effect of the stirring Speed

We prepare solutions of fluoride at temperature of 19 °c and pH=6.70.The concentration of fluoride anions is: 3mg/l and the volume of samples is 100ml. The amount of activated carbon is 1 g. The results are as follows:

Table 08: the effect of stirring Speed

The Number of Samples	Stirring Speed (Round/ min)	The remaining Concentration Of Fluoride [F⁻] (mg/l) When treated by camel bones activated carbon	The treatment yield%When treated by camel bones activated carbon	The remaining Concentration Of Fluoride [F⁻] (mg/l) When treated by cow bones activated carbon	The treatment yield %When Treated by Cow Bones activated carbon	The remaining Concentration of Fluoride [F⁻] (mg/l) When treated byCrataegus azarolus nucleus activated carbon	The yield Treatment%When treated byCrataegus azarolus nucleus activated carbon
1	100	2.49	17	2.70	10	2.79	7
2	200	2.45	18.33	2.67	11	2.75	8.33
3	300	2.42	19.33	2.63	12.33	2.73	9
4	500	2.50	16.66	2.71	9.66	2.77	7.66
5	700	2.55	15	2.75	8.33	2.82	6

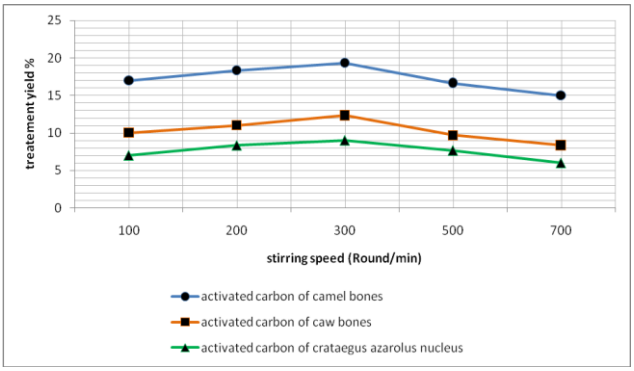


Figure 13: the effect of stirring Speed on *the treatment yield %*

-We note that as the stirring speed increases, the adsorption of fluoride anions increases. It is explained by the contact between the anions of fluoride and the surface of activated carbon. This is up to 300 R/min. Then, a decrease in adsorption of fluoride anions on the surface of active carbon starts. It is explained by the increase of stirring power, leading to the separation of fluoride anions.

4.6 The effect of pH

We prepare samples of fluoride solutions at a temperature of 19 °c and a 3mg/l- concentration of fluoride anions. The volume of each sample is 100 ml. The amount of activated carbon is 1g. The contact time was one hour and half. The obtained results areas follows :

Table 09: the effect of pH

The Number of Samples	pH	The remaining Concentration Of Fluoride [F^-] (mg/l) When treated by camel bones activated carbon	The treatment yield %When treated by camel bones activated carbon	The remaining Concentration Of Fluoride [F^-] (mg/l) When treated by cow bones activated carbon	The treatment yield %When Treated by Cow Bones activated carbon	The remaining Concentration of Fluoride [F^-] (mg/l) When treated byCrataegus azarolus nucleus activated carbon	The yield Treatment%When treated byCrataegus azarolus nucleus activated carbon
1	4	2.58	14	2.70	10	2.90	3.33
2	5	2.52	16	2.67	11	2.82	6
3	6	2.45	18.33	2.65	11.66	2.76	8
4	7	2.41	19.66	2.60	13.33	2.70	7.66
5	8	2.48	17.33	2.68	10.66	2.78	6

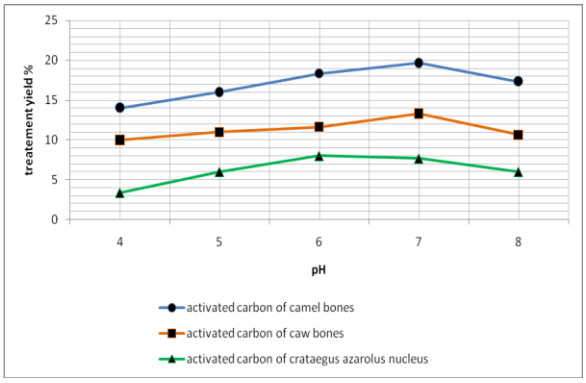


***Figure 16: The effect of pH on** the treatment yield%*

We note that when the pH of the sample was moderate, we had more adsorption. thus, pH=7 Is the optimum value of the treatment . This is caused by activated carbon which contain samphoteric functional groups resulting in the existence of attraction between them and the fluoride anions making adsorption higher when the pH=7.

5 CONCLUSION

We have concluded from these experiments that we can exploit cow and camel bones and nucleus of Crataegus azarolus in water treatment from fluoride anions. In addition, the best treatment results are applicable for (pH = 07, stirring speed, contact time and amount of activated carbon could be applicated actually). This contributes to fight dental and bones fluorosis rampant in several parts of the world, particularly in south Algeria.

-The results of analysis of water of Batna proved that there are some deficiencies in the concentration of fluoride anions in most areas of this state and this explains absence of fluorosis among the people of this state ,but this lack should be compensated with eating fluoride-rich food such as dates and fish.

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