

Quality Assessment of Various Bottled Water Marketed in Algeria: Health-Related Effects

Short title: Chemical quality of bottled water marketed in Algeria

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ABSTRACT

Forty-two different brands between mineral & spring waters were purchased from varied markets in Algeria, they analyzed for their bacteriological quality & chemical major elements. The results showed that all the brands presented good bacteriological quality (Absence of *E. coli*, Total coliforms, *Ps. aeruginosa*, *enterococci* & anaerobic spores). Piper diagram shown that (76.19%) of the samples were classified as Earth Alkaline water, where (80%) of them belong to dominant HCO_3^- . By comparing the results with the WHO standards we found that only (16.67%) of the brands are compliant with the standards: *Ain Bouglez*, *Righia*, & *Besbassa* as spring waters, *Texanna*, *El Goléa*, *Salsabil* & *Lalla Khadidja* as mineral waters, those last two they have not enough *TDS* to consider them as mineral waters like mentioned in their labels, which confirmed by dendrogram classification. Otherwise, when the results compare with the Algerian standards, all the brand waters turned to be compliant with them except for *Arwa*. Consumers must be very wary about the consumption of bottled water, especially if they already have health issues because they cannot make a choice only from the labels which are mostly different from the real chemical composition.

Keywords: Algeria, health-related effects, mineral water, Piper diagram, spring water.

HIGHLIGHTS

- Labels do not necessarily identify the real concentration of chemical components.
- Nitrate value exceeds in the bottled water: *Arwa* by 60 mg/L.
- Algerian standards of drinking water are very lenient compared with the *World Health Organization* standards.
- The 42 bottled water brands were classified into 16 types with 70% similarity between them, using dendrogram classification.

GRAPHICAL ABSTRACT



INTRODUCTION

Water is necessary for life and continuity, particularly safe drinking-water that guarantees significant health benefits; *World Health Organization* guidelines define safe drinking-water as it does not represent any significant risk to health over a lifetime of consumption (WHO 2017). People believe the idea that bottled water is healthy, cause of its richness by minerals which confer health benefits (Baba et al. 2008; Ward et al. 2009; Sharaf et al., 2021). Murakami et al. (2015) proved in their study that serum glycol-albumin levels were significantly decreased after Bicarbonate Mineral Water consumption (*BMW*) it tends to lower blood sugar levels, which may prevent and/or improve type 2 Diabetes. Whilst, nitrate may have the effect of protecting the gastrointestinal tract from various gastrointestinal pathogens, because nitrous oxide and, acidified nitrite have antibacterial properties (WHO 2017). Also, potassium maintains the normal osmotic pressure in cells with sodium; it is a cofactor for many enzymes, a sufficient loss of potassium can result in Hypocalcaemia, which causes: cardiac arrhythmia, muscle weakness, nausea, vomiting, and low muscle tone in the gut. Longer-term hypocalcaemia causes a predisposition to hypertension, (Udhayakumar et al. 2016). Wherefore Osteoporosis patients should select water with high calcium, and magnesium concentrations to help with their skeletal fragility (Chiarenzelli & Pominville 2008).

Salt minerals are vital for human body as they can be toxic if consumption is excessive, and this may in some cases be baneful (Stanhope 2018). Prolonged consumption of water with high EC (*Electrical conductivity*) and TDS (*Total Dissolved Solids*) may cause hypertension, heart attack, gastrointestinal irritation, and renal calculi (Udhayakumar et al. 2016; Rahman & Rahaman 2018). Furthermore if serum calcium level rises to 160mg/L may cause coma, and death; too high magnesium causes nausea, muscular weakness, and paralysis when it reads a level of about 400 mg/L (Udhayakumar et al. 2016). Therefore, patients with kidney stone issues can benefit from avoiding hard or mineralized waters. And those suffering from hypertension should monitor their sodium intake, and avoid waters with high sodium content (Chiarenzelli & Pominville 2008). Excess in chlorine and sodium is harmful to people suffering from cardiac, circulatory, and kidney diseases. High sodium levels may cause hypertension with congestive heart failure (Udhayakumar 2016). Nitrate is the main contaminant in water, capable of causing acute toxicity problems; it may be a sign of other contaminants (Fortunato et al. 2020). It is lately cancerous as reduction to nitrite can occur in the organism with primarily gastric cancers. The ingestion of water that contains nitrate over 50 mg/L to 100 mg/L may give rise to infantile methaemoglobinaemia. (WHO 2017), simultaneous gastrointestinal infections may alter human thyroid gland function by competitively inhibiting thyroidal iodide uptake, leading to altered thyroid hormone concentrations, and functions, (Ward et al. 2009; WHO 2017) nitrate in water may also be related to the occurrence of childhood diabetes.

With all these facts, the consumer remains confused about choosing the best for his body, especially with the existence of many brands in the market. According to Algerian ministry of trade in 2016, the number of bottled water processing units is forty-two, in operation (42 Brands between mineral, and spring waters), and thirty-one planned units (concession granted). Consumers in Algeria always believe that bottled water is healthy and safe regardless of spring or mineral water. Mostly they are keen to take it with their medication during treatment, and whenever they can especially, for the elderly, pregnant women & children.

Our study aims to give the opportunity to get acquainted with the quality of bottled water sold in the Algerian market. In this study, we analyzed the major components of bottled waters; their conformity with the international and local standards; and whether they pose a risk to the consumer's health.

METHODS

Over a span of two years (from 2018 to 2020), 42 different brands of spring water, and mineral water samples were purchased from various supermarkets in Algeria. The brand name, manufacturing and expiry dates, batch number, the chemical contents and the address of manufacture were documented in proforma. The water samples were coded and stored in the dark at room temperature and quickly analyzed in the laboratory. The water samples were analyzed just after its opening first for its bacteriological quality then for its chemical contents. The analyses were achieved according to APHA (2017)& Rodier et al.(2009) methods.

Bacteriological analysis

The under groundwater is naturally protected from the contamination of pathogenic bacteria, but there are many microorganisms in surface water. The contamination of spring and mineral water can happen during bottling. The bacteriological quality measured by the indicator organisms, in particular: Total coliforms, *Escherichia coli*, *Pseudomonas aeruginosa*, *enterococci*, and sulfite-reducing anaerobic spores, using the membrane filtration method (the media used in the analysis provided by Conda pronadisa).

Physicochemical analysis

The pH, EC, and salinity measurements were determined by using pH meter (HACH, sens pH3) and, conductivity meter (HACH, sens IONTM+EC7) respectively. The water samples' chemical constituents such as chloride Cl^- , magnesium Mg^{2+} , and bicarbonates HCO_3^- were analyzed by titrimetry Cl^- using standard $AgNO_3$, Mg^{2+} concentration was esteemed by standard EDTA while carbonate and bicarbonates were estimated by titration with HCl. The dry residues at 180°C were determined by drying method using oven (BINDER 300°C) and the loss on ignition at (525°C±25) was determined by furnace (Nabertherm B180). The calcium, potassium, and sodium were analyzed by flame photometer (PFP7 JENWAY). A UV-Visible spectrophotometer (SHIMADZU UV-1800) was used to determine the sulfate SO_4^{2-} and nitrate NO_3^- concentrations.

Data analysis

The physicochemical data were studied by graphic treatment with Piper class scatter plot using (Grapher 17 software) for better understanding of samples' hydrogeochemical quality. Compare the results with WHO's drinking water standards and Algerian standards (using Graphpad prism8) to determine which of our water samples are conform to the norms and which may have health risks. Finally, the water samples were classified to unknown groups depends on its similarity of their physicochemical results using clusters dendrogram by Statistica software.

RESULTS

Bacteriological quality

The bacteriological results showed that all samples are exempt from pathogenic bacteria. No colonies detected in Cetrimide medium. The test results of *Ps. aeruginosa*, *E. coli*, Total coliforms, Enterococci & anaerobic spores were also negative. These outcomes indicate that all samples were completely conforming to the Algerian drinking water standards (Interministerial Decree 2016) and the WHO standards.

Chemical quality

The physicochemical results of water samples are summarized in Tables 1 & 2.

Table1: Physicochemical parameters of mineral water samples.

<i>Brands</i>	<i>pH</i>	<i>EC</i>	<i>TDS</i>	<i>Ca²⁺</i>	<i>Mg²⁺</i>	<i>Na⁺</i>	<i>K⁺</i>	<i>Sali nity</i>	<i>Cl⁻</i>	<i>SO₄²⁻</i>	<i>HCO₃⁻</i>	<i>NO₃⁻</i>	<i>Dry resid ues 180°</i>	<i>Los s- on- igni tion</i>
		<i>µs/cm</i>	<i>mg/L</i>	<i>mg /L</i>	<i>mg/ L</i>	<i>mg /L</i>	<i>mg /L</i>	<i>mg/ L</i>	<i>mg/ L</i>	<i>mg/ L</i>	<i>mg/ L</i>	<i>mg /L</i>	<i>mg/L</i>	<i>mg/L</i>
<i>LallaKha didja</i>	7. 8	282.3 1	242.4 6	24	14.	03	0.7	116	35.4 5	30	122. 03	2.3 0	41	6
<i>Texanna</i>	7. 5	337.7 4	269.8 4	18	8	20	3.2	147. 3	35.4 5	20.3	152. 54	2.3 6	98	54
<i>Guedila</i>	7. 5	819.5	654.7 5	54	35	30	2.4	356	70.9 1	108. 09	305. 1	4.6 7	400	90
<i>Ifri</i>	7. 3	888.6	752.2 3	10 0	44	50	1.9	374	99.3	80	305. 1	22. 13	406	72
<i>Alma</i>	7. 4	1135. 64	961.4 0	13	57	18	5.5	481	141. 81	100	335. 6	23. 5	602	243
<i>Lavita</i>	7. 3	1853. 95	1569. 43	16 0	112	17	2.7	810	184. 36	127. 5	762. 71	17. 3	979	123
<i>ElGoléa</i>	7. 8	326.2 1	280.2	16	11	33	14	142. 3	35.4 5	44	91.5 3	9.8 3	192	146
<i>Salsabil</i>	7	256.5 3	220.3 2	24	3	25	4.2	120. 8	71	6.7	76.3	10. 23	155	135
<i>Saida</i>	7	1214. 02	1028	66	56	69	2.8	530	127. 63	120. 5	274. 6	38. 2	501	27
<i>Baniane</i>	7. 25	930.8 1	788	63	50	31. 5	2.9	403	49.6 3	148	293	3.2	535	321
<i>Mouzaia</i>	7. 3	1765. 23	1494. 33	10 0	100	15 5	3	763	156	200	714	18. 5	705	91
<i>Thevest</i>	7. 7	885.1	749.2 3	84	40	10 2.5	3.2	439	78	205. 38	238	2.4	541	248
<i>Toudja</i>	7. 6	432.6	346	41. 7	12. 33	27	1	231	63.8 2	16	171	0.9 3	262	120
<i>Messergh ine</i>	8	713.9 3	570.4 1	22	15	73	1.2	342	132	79	213. 6	5.5 4	368	305
<i>Youkous</i>	7. 7	438.4	350.2 53	37	7	25	2.8	172. 7	45	36	170	3.5	342	136
<i>ManbaaE lghezlane</i>	7. 44	955.5	809	11 5	19	80	1	385	120	160	270	22	719	202
<i>WHO (1996, 2017)</i>	6. 5- 8. 5	400	<i>Min</i> 250 <i>Max</i> 6 00	10 0	30	20 0	-	150	250	250	500	50	-	-
<i>Algerian Standard s (Ex.D 2014)</i>	6. 5- 8. 5	2800	-	20 0	-	20 0	12	-	500	400		50	1500	-

Table 2:Physicochemical parameters of spring water samples.

<i>Brands</i>	<i>pH</i>	<i>EC</i> <i>µs/cm</i>	<i>TD</i> <i>mg/L</i>	<i>Ca²⁺</i> <i>mg/L</i>	<i>Mg²⁺</i> <i>mg/L</i>	<i>Na⁺</i> <i>mg/L</i>	<i>K⁺</i> <i>mg/L</i>	<i>Sali</i> <i>nity</i> <i>mg/L</i>	<i>Cl⁻</i> <i>mg/L</i>	<i>SO₄²⁻</i> <i>mg/L</i>	<i>HCO₃⁻</i> <i>mg/L</i>	<i>NO₃⁻</i> <i>mg/L</i>	<i>Dry</i> <i>resid</i> <i>ues</i> <i>180°</i> <i>mg/L</i>	<i>Loss</i> <i>-on-</i> <i>ignit</i> <i>ion</i> <i>mg/L</i>
<i>Ain-</i>	7.	131.	139	<1	2.1	10	1	55	42.	18.	30.	8.4	36	2
<i>Bouglez</i>	5	9	.45	5					54	3	5	9		
<i>Hassia</i>	7.	763.	609	63	12	23	2.5	334	219	35.	30.	31.	322	86
	3	4	.94						.8	07	5	17		
<i>Tazliza</i>	7.	741.	592	60	29	50	10.	315	106	13	91.	19.	366	74
	7	5	.43				3		.35	6	52	47		
<i>El</i>	7.	941.	796	69	17	45	2.9	406	63.	14	366	35.	510	136
<i>Ghadir</i>	6	2	.8						82	8	.1	11		
<i>Ouwis</i>	7	992.	839	63	30.	51	1.3	435	78	17	274	12.	534	125
		1	.85		5					6	.6	30		
<i>Lajdar</i>	7.	712.	569	60	35	40	2.9	310	42.	62	305	8.4	359	59
	8	54	.3						54		.1	2		
<i>Righia</i>	7.	132.	140	<1	0	32	2	52.2	35.	0	156	3.5	109	109
	6	85	.5	5					45		.2	2		
<i>Fezguia</i>	7.	594.	475	57	5	23	1.2	260	28.	54	274	23.	361	76
	7	5							4		.6	9		
<i>Mileza</i>	7.	103	872	63	33	56	1.5	440	21.	21	396	2.6	539	84
	44	0							3	5	.6	0		
<i>Nestle-</i>	7.	538.	430	45	13	41.	1.5	226	28.	47	207	5.8	160	14
<i>Purelife</i>	64	9	.55			5			4		.5	8		
<i>Togi</i>	7.	669.	535	60	18.	35	2.2	281	56.	34	274	8.4	276	0
	5	72	.1	7					72		.6	8		
<i>Ovitale</i>	7.	716.	572	69	23	35.	2.6	303	56.	15	219	16.	361	66
	5	9	.75			25			72	6	.7	03		
<i>BirEssal</i>	7.	872.	738	69	22	41.	2.1	371	28.	11	341	3.3	501	33
<i>am</i>	4	9	.91			25			4	1	.7	8		
<i>Soumma</i>	7.	177	150	15	70	11	3.2	770	304	26	347	33.	835	141
<i>m</i>	5	2	0	0		0			.9	0	.8	03		
<i>Arwa</i>	7.	133	113	12	43	66	1.3	579	163	23	329	60	581	79
	2	8.55	3.1	5					.1	7	.5			
<i>MontDju</i>	7.	800.	639	69	17.	63	2.5	378	85.	50	311	20.	501	317
<i>rdjura</i>	2	31	.42		9				1		.2	76		
<i>Ifren</i>	7.	441.	353	42	5.9	26.	2	226	28.	30.	201	2.6	116	1
	4	8				25			36	4	.35	0		
<i>Ayris</i>	7.	469.	375	48	6.5	7	1	248	49.	45	201	4.7	266	99
	6	7	.3						63		.35	7		
<i>Star</i>	7.	739.	590	10	13	20	1	399	78	49	286	31.	543	201
	35	2	.6	5							.8	36		
<i>Gueriou</i>	7	547.	437	54	2.5	14	1	261	142	60	135	17.	404	305
<i>ne</i>		34	.31								.6	76		
<i>Besbassa</i>	7.	345.	275	69	1.7	45	1	135.	60	12	70	11.	279.	120
	7	34	.92					4				27	9	

<i>SidiRach</i>	7.	608.	485	80	5	50	2	241	60	35	207	35	526.	141
<i>ed</i>	55	21	.94										5	
<i>El-</i>	7.	713.	570	70	3	35	1.2	284	55	75	300	22	562	160
<i>Kantara</i>	56	83	.33											
<i>DjebelA</i>	7.	656.	524	45	6	30	<0	262	45	10	240	43.	307	120
<i>mour</i>	63	4	.4				.2			0		85		
<i>Lajdar</i>	7.	712.	569	60	35	40	2.9	310	42.	62	305	8.4	359	59
	8	54	.3						54		.1	2		
<i>Taya</i>	7.	473.	378	50	11	65	1	187.	117	99	65	28	490	200
	5	5	.3					1						
<i>Messad</i>	7.	769.	614	75	7	60	1	307	170	16	120	1.1	600	322
	6	2	.6							0		9		

The chemical contents of water depend on the composition of rocks from which it is extracted and by geochemical processes (Van der Aa 2003). The hydrogeochemical was evaluated by Piper trilineardiagram shown in Figure 1.

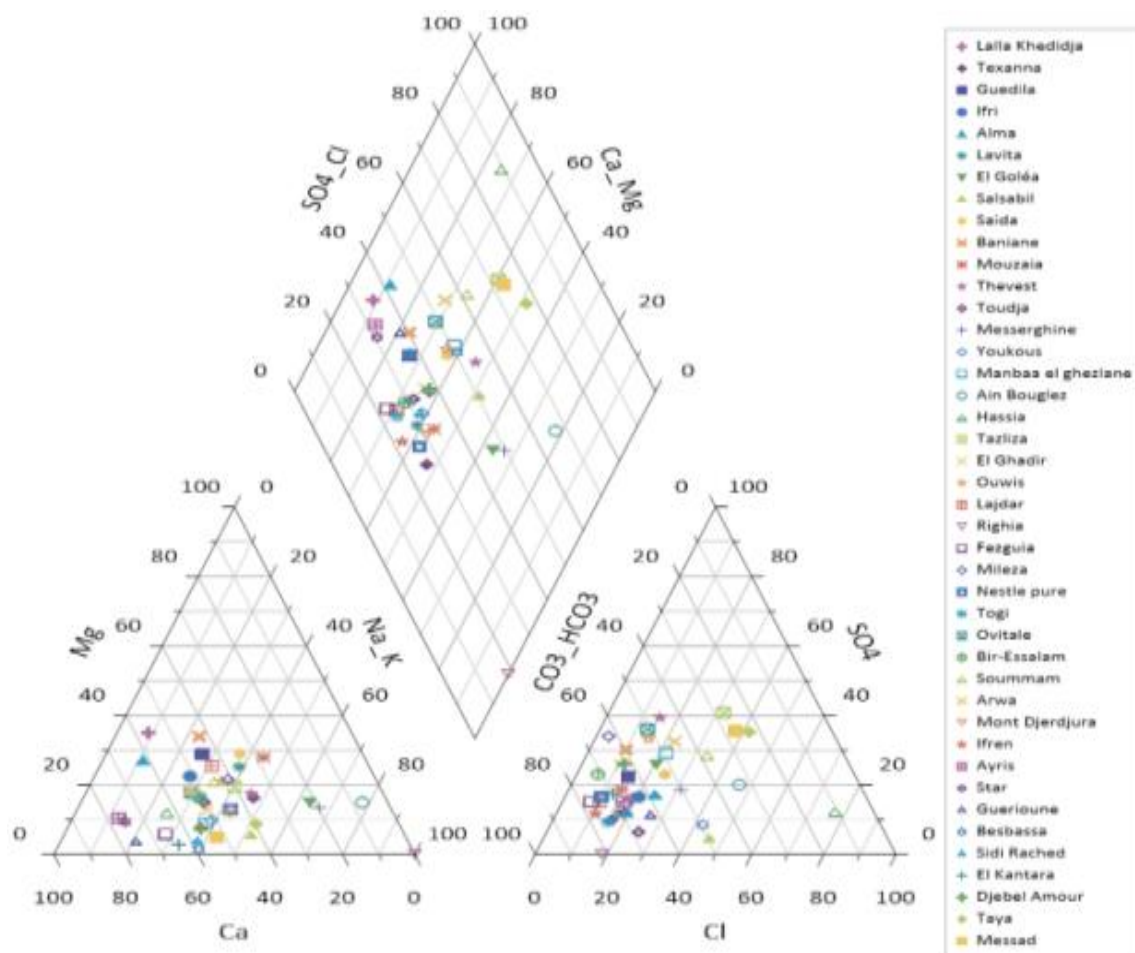


Figure 1: Piper Trilinear diagram showing the type of water samples.

DISCUSSION

The diagram allowed us to classify the waters samples using the main cations Ca^{2+} , Mg^{2+} , Na^+ , K^+ and, anions Cl^- , SO_4^{2-} , HCO_3^- , NO_3^- (Piper 1944; Ravikumar et al. 2015; Varol & Şekerçi 2018). Only (9.5%) of samples were classified as Normal earth

alkaline waters: *Lalla khadidja*, *Star*, and *Ayris* with dominant bicarbonate, *Alma* with dominant bicarbonate & chloride. (14.28%) of samples belong to the alkaline water: *El Goléa*, *Messerghine*, *Salsabil* & *Ain Bouglez* with dominant bicarbonate, *Righia* with dominant chloride. Most samples (76.19%) were classified as Earth Alkaline water, where (80%) of them belong to dominant HCO_3^- .

The pH of samples varied from 7 to 8, which is within the 6.5-8.5 range recommended for drinking water (*Executive Decree* 2014; WHO 2017).

The EC values vary from normal: *Lalla Khadidja*, *Texanna*, *ElGoléa*, *Salsabil*, *Ain Bouglez*, *Righia* & *Besbassa*, into high in both mineral & spring water samples ($131.9\mu\text{cm}^{-1}$ – $1853.95\mu\text{cm}^{-1}$), The EC value of more than 83% of water samples is higher than the allowable WHO value for drinking water: $400\mu\text{cm}^{-1}$. However, the EC threshold is $2800\mu\text{cm}^{-1}$ in Algerian standards (*Executive Decree* 2014; Tahmasebi et al., 2020), which makes all water samples compliant with the Algerian permissible limit for EC. The EC is proportional to the TDS. Drinking-water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000mg/L (WHO 2017): *Lavita*: 1569.43mg/L , *Mouzaia*: 1494.33mg/L and *Saida*: 1028mg/L , also with the bottled spring water: *Soummam*: 1500mg/L & *Arwa*: 1133.1mg/L , whereas (45.23%) of samples exceeded the allowable limit of TDS: 600mg/L . The US Food and Drug Administration (FDA) describes natural mineral water as water containing at least 250mg/L of TDS (Ong et al. 2009), which is not carried out with two water samples labeled as natural mineral water: *Lalla khadidja*: 242.46mg/L & *Salsabil*: 220.32mg/L . The palatability of water samples related to TDS concentrations is shown in Table 3.

Table 3: The palatability of water samples based on their TDS concentrations.

		TDS Concentrations (mg/L)				
Drinking water quality (WHO 1996)		Excellent <300	Good 300-600	Fair 600-900	Poor 900-1200	Unacceptable > 1200
Mineral samples	water	<i>Lalla khadidja</i> <i>Texanna</i> <i>El Goléa</i> , <i>Salsabil</i>	<i>Toudja</i> <i>Messerghine</i> <i>Youkous</i>	<i>Guedila</i> <i>Ifri</i> , <i>Baniane</i> <i>Thevest</i> <i>Manbaa el ghezlane</i>	<i>Alma</i> <i>Saida</i>	<i>Lavita</i> <i>Mouzaia</i>
Spring samples	water	<i>Ain Bouglez</i> , <i>Righia</i> <i>Besbassa</i>	<i>Tazliza</i> <i>Lajdar</i> <i>Fezguia</i> <i>Nestle Pure life</i> <i>Togi</i> <i>Ovitale</i> <i>Ifren</i> <i>Ayris</i> , <i>Guerioune</i> <i>Sidi Rached</i> <i>El Kantara</i> <i>Djebel Amour</i> <i>Taya</i>	<i>Hassia</i> <i>El Ghadir</i> <i>Ouwis</i> <i>Mileza</i> <i>Bir-</i> <i>Essalam</i> <i>Mont</i> <i>Djurdjura</i> <i>Messad</i>	<i>Arwa</i>	<i>Soummam</i>

The Calcium concentrations exceed the WHO permissible limit (WHO2017) in six samples (they represent 14.28 %), where the upmost concentration is: 160 mg/L, for *Lavita* mineral water. In the spring waters: *Righia*&*Ain Bouglez* the calcium concentrations were below the detection limit. The calcium concentrations of water samples were within the permissible limit of Algerian standards.

The magnesium concentrations ranged from 0 to 112mg/L, (30.95%) of samples exceeded the limit; the highest value detected with *Lavita*.

The potassium and sodium concentrations of all samples are within the allowable range. Also, the chloride concentrations were within the WHO permissible limit unless with the spring water *Soummam*: 304.9mg/L, as well still conform to the Algerian standards, while (80.95%) of samples exceeded the threshold limit of NaCl specified by the WHO at 150mg/L(WHO 1996).

According to WHO standards (WHO 2017), the permissible limit for sulfate is 250 mg/L. We noticed that all water samples were within the threshold limit unless for the mineral water *Soummam*: 260 mg/L however, it conforms according to the Algerian standards where the permissible limit for sulfate is 400mg/L.

The WHO threshold limit of bicarbonate is 500mg/L, in all samples the bicarbonate values are within the standards, except for one mineral water: *Lavita*: 762.71mg/L.

The nitrate maximum limit is given by 50 mg/L according to WHO and Algerian standards. The nitrate originates from organic matter degradation. Due to agricultural activities, it can reach groundwater and/or occasionally natural vegetation (WHO 2017; Adamou et al. 2020) only the spring water *Arwa* exceeded the permissible limit by 60 mg/L.

The loss on ignition measurement allowed us to determine approximately the organic matter in dry residues due to decompositions and volatilizations of mineral salts. Organic matter is the cause of such aesthetic concerns as color, taste & odor (Rodier et al. 2009). The highest organic matter concentrations were observed with: *Lavita*: 856 mg/L & *Soummam*: 694 mg/L, while the lowest concentration was with: *Righia* spring water: 0 mg/L. Generally, we estimated a high organic matter in all water samples except for *Lalla Khadidja*, *El Goléa*, *Salsabil* & *Ain Bouglez*.

We can observe clearly in Figure 2, whether or not the samples comply or not with both Algerian standards and the WHO drinking water guidelines.

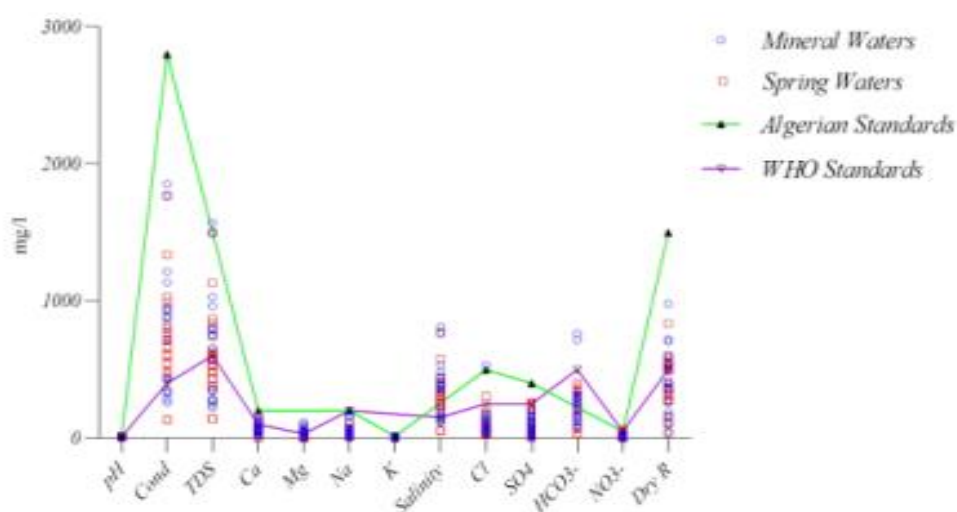


Figure 2: The chemical composition of water samples compared with WHO & Algerian standards.

The Algerian standards' limits are very high which allows all the water types to be within the range even with their high mineralization except for *Arwa*.

Conversely, the WHO drinking water standards are strict; allow only a few brands of bottled waters to be safely used as potable water. Consequently, only 16.67% were compliant with the norms: *Ain Bouglez*, *Righia* & *Besbassa* as spring water, *Texanna* & *El Goléa* as mineral water. *Salsabil* and *Lalla Khadidja* were compliant with the drinking water standards, but not as natural mineral water as indicated on their labels because their *TDS* concentrations were below the minimum level.

As well Figure 2 allowed us to notice the overlapping in the chemical parameters of spring and mineral water. No uniformity between the same-category brands. We observed water brands labeled as natural mineral waters have low mineralization, per contra spring waters with very high mineralization, as *TDS* in *Soummam* is 1500 mg/L. In this regard we read out that, the designation of bottled water as mineral or spring water was done randomly.

Which is approved after classifying all samples into unknown groups depends on their similarity of their physicochemical results using clusters dendrogram (Figure 3).

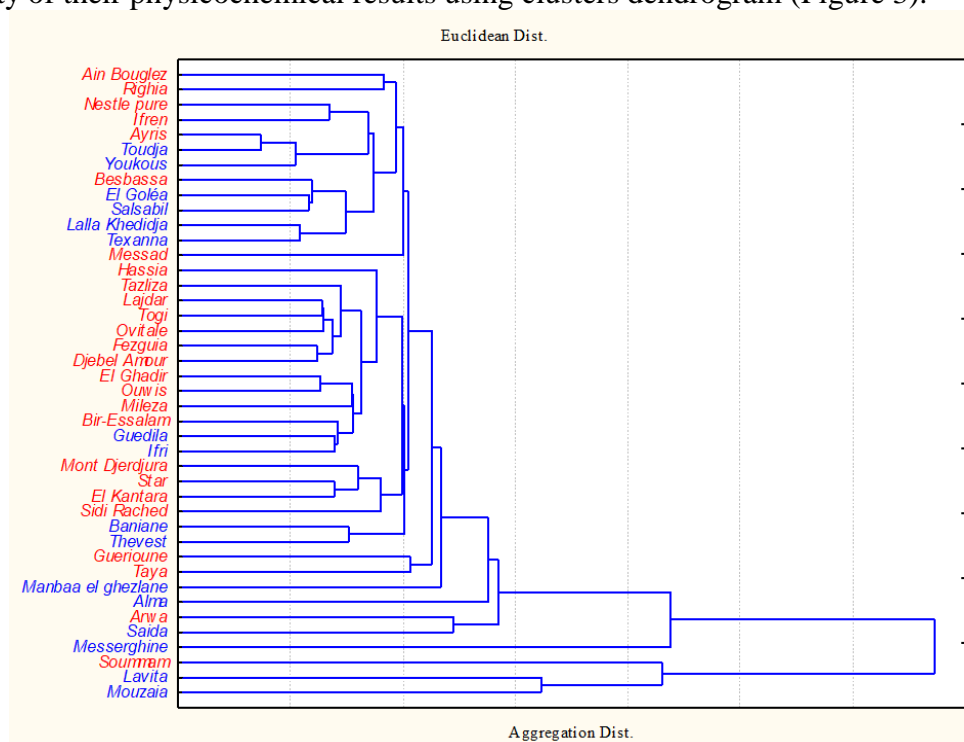


Figure 3: Dendrogram of 42 bottled water samples.

This classification is called Q-mode classification (Belkhiri et al. 2010) *Ain Bouglez* was very close to *Righia*, had equally distant, which means they are similar; this is because both springs water filled from the same area. From this point, we could count sixteen clusters with (70 %) of similarity, starting from the top of dendrogram: **1** (*Ain Bouglez* & *Righia*) **2** (from *Nestle life pure* to *Texanna*) **3** (*Messad*) **4** (from *Hassia* to *Ifri*) **5** (From *Mont Djurdjura* to *Sidi Rached*) **6** (*Baniane* & *Thevest*) **7** (*Gueriouone*) **8** (*Taya*) **9** (*Manbaa elghezlan*) **10** (*Alma*) **11** (*Arwa*) **12** (*Saida*) **13** (*Messerghine*) **14** (*Soummam*) **15** (*Lavita*) & **16** (*Mouzaia*).

We noticed that the mineral water: *Toudja*, *Youkous*, *ElGoléa*, *Lalla Khadidja* are situated on the range close to spring water, which is consistent with Hazzab (2011) study's results, same remark with *Salsabil* & *Texanna*. As well, some spring waters are situated close to the mineral waters range as *Arwa* & *Soummam*.

CONCLUSIONS

Forty-two water brands were analyzed; where all were bacteriologically safe as the results shown. The hydrochemical quality showed that 76.19% of samples are Earth Alkaline water with HCO_3^- dominants mostly. The physicochemical data of 14 parameters compared with *WHO* and *Algerian standards*. 83.33% of brands did not conform to the *WHO's* drinking water guidelines, which may pose risk to consumers with health issues, infants, young children, debilitated people, & the elderly. We concluded that not all bottled water is safe for all categories of people, the selection between water types must be based on chemical composition mentioned in labels and health condition of the consumer, that's why we suggest adding some important information on label, such as *TDS* concentration. Furthermore, 97.62% of samples are compliant with the *Algerian standards*, the large differences between the local and the international standards; affect the export trade of bottled water and consumer's health.

We recommend that the Algerian standards adapt to international drinking-water standards and apply strict control of the bottled water labels and their updating, whenever required to avoid the falsification and random nomination among spring and mineral water.

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