Identification of Emerging Contaminants in Drinking Waters

Sana Mokrane, Djamila Harik, and Hubert Cabana

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Emerging contaminants • Residues • Pharmaceuticals • Pesticides • Detection • Elimination

1 Introduction

The presence of contaminants of emerging concern (CEC) in drinking water was reported in many studies Reddersen et al. (2002), Benotti et al. (2008), Dunn et al. (2014). Organic contaminants such as pharmaceuticals and pesticides residues which result from human activities in different sectors, and escape from traditional treatments by wastewater treatment plants (WWTPs) Haroune et al. (2017), Verlicchi et al. (2012), Boussahel et al. (2003), so they might affect human health Focazio et al. (2008).

After a physico-chemical analysis of three Algerian drinking waters, we presented a contribution to the identification of some emerging pollutants in drinking water of four municipalities in South Central Quebec Canada. This identification is a very important step and a basis in the field of treating drinking water might be applied on Algerian waters to verify the presence of contaminants of emerging concern (CEC) in order to predict the process of their elimination.

S. Mokrane (✉) · D. Harik
Ecole Nationale Polytechnique d'Alger, El-Harrach, Algeria
e-mail: sana.mokrane@g.enp.edu.dz

D. Harik
e-mail: djamila.harik@g.enp.edu.dz

H. Cabana
Université de Sherbrooke, Sherbrooke, Canada
e-mail: Hubert.Cabana@USherbrooke.ca

2 Materials and Methods

2.1 Physico-Chemical Analysis of Drinking Water

The quality of drinking water was confirmed by the results of some parameters (by adopting the ISO methods) achieved by Science and Techniques of Environment laboratory (LSTE) of Polytechnic School of Algiers and SEAAL (Algerian Society of Water and Sanitation) in Boudouaou. The parameters were.

The hydrogen potential (pH), conductivity, turbidity, ammonia nitrogen, nitrates, nitrites, phosphates, the organic matter (OM), magnesium and calcium ions, total hardness TH, chloride, alkalinity, chemical oxygen demand (COD), test on marble and active chlorine.

2.2 Liquid-Liquid Extraction Method

Drinking water samples were collected from taps into new amber glass bottles during winter (February 2017). Samples were then divided in two equal volumes to make replicates and were put each in separating funnel, 2% w/v of NaCl were added, then extraction was performed at first by adding 10% v/v of Dichloromethane and then repeated with 10% v/v of Ethyl acetate. The organic phase was collected into glass vial and in order to concentrate it. It was all evaporated to dryness under gentle stream of nitrogen before re-solubilization with 2 ml of methanol. Suspensions were then filtered through 0.2 µm filter before transfer into UPLC vial for quantitative analysis. Samples were stored at 4 °C until analysis by UPLC-MS/MS Ba et al. (2014).

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3 Results and Discussion

3.1 Physico-Chemical Analysis of Three Algerian Drinking Waters

The usual water analysis results show that drinking water values of all parameters respect the potability standards required by the Republic of Algeria and the World Health Organization (WHO), and we can conclude that these samples are potable (Table 1).

3.2 Identification of Some Emerging Contaminants in South Center Quebec

Treated drinking water was analyzed for the presence of 70 chemicals, 20 molecules were detected (7 pharmaceuticals and 13 pesticides). The results shown below (Table 2) indicate that the municipality which waters contained high concentrations of pesticides is Sherbrooke while the one with high pharmaceuticals contents is Drummondville; these different amounts of chemical residues are related to many

Table 1 Physico-chemical analysis of three Algerian drinking waters

Samples / Parameters	Mineral water (Guedila)	ENP Water tap	Home Water tap	Potability standards
pH	7.52	7.92	8.01	6.5 à 8.5
Conductivity (µs)	767	1089	1016	2800
Turbidity (NTU)	0.144	0.277	0.34	5
Ammonia NH_4^+ (mg/l)	<0.015	<0.015	<0.015	0.5
Nitrates NO_3^- (mg/l)	3.62	4.134	4.167	50
Nitrites NO_2^- (mg/l)	<0.02	<0.02	<0.02	0.2
Phosphates PO_4^{3-} (mg/l)	<0.015	<0.015	<0.015	0.5
Permanganate Index (IMn) (mg/l)	–	1.84	1.2	5
Mg^{2+} and Ca^{2+} ions (mg/l)	$[Mg^{2+}] = 45$ $[Ca^{2+}] = 80$	$[Mg^{2+}] = 38$ $[Ca^{2+}] = 76$	$[Mg^{2+}] = 36$ $[Ca^{2+}] = 84$	$[Mg^{2+}] = 150$ $[Ca^{2+}] = 200$
TH (°f)	38	34	36	(*)
Chloride Cl^- (mg/l)	51.68	148.6	103.37	500
Alkalinity TAC (°f)	27	22	18	
COD (mg/l)	<30	<30	65	<250
Is	−0.14	0	0.1	(**)
Active chlorine Cl_2 (mg/l)	0.06	0.18	0.08	No value detected, but we can notice the taste from 250 mg/l and above

(*):

TH (°f)	0–7	7–15	15–30	30–40	+40
Water	So pure	Pure	Little hard	Hard	Very hard

(**): When the saturation index is: Is > 0, water is « incrustante »
Is = 0, water is « inert »
Is < 0, water is « aggressive »
(*): is about (Total Hardness (TH))
(**): is about saturation index

Table 2 Concentration of some pharmaceuticals and pesticides found in drinking water of four different municipalities in South Center Quebec with their treatment method

	Pharmaceuticals (ng/l)	Pesticides (ng/l)	Drinking water treatment method
Sherbrooke 1 Sherbrooke 2	0.0656 0.0336	0.112 0.1704	Chlorination, ozonation, micro-straining
Richmond 1 Richmond 2	0.0696 0.0648	0.0648 0.0288	Chlorination, filtration, iron/manganese
Drummond 1 Drummond 2	0.1136 0.1288	0.0944 0.1384	Chlorination, filtration, charcoal
Windsor 1 Windsor 2	0.0696 0.0608	0.1112 0.0376	–

factors like demography, treatment methods, size of the sector that provides these products and their consumption and price Kookana et al. (2014).

4 Conclusion

Usual physico-chemical analysis showed that the consumed Algerian drinking waters answer globally the international standards, furthermore, deeper quantitative analysis on Canadian drinking waters highlighted the presence of residues of emerging contaminants such as pharmaceuticals and pesticides. These pollutants may cause several problems to human health and thus their identification is crucial with the view to eliminate them.

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