International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2014): 5.611

Physicochemical Characterization of Water from Nioro

Sidi M. Tounkara[1], Babakar Diop[2], Drissa Samaké[3], Boubacar Traoré[3]

[1]Physics and Chemistry Department of Ecole Normale Supérieure (ENSup) Bamako
[2]Institute of Applied Science (ISA) Bamako
[3]Analytical Chemistry Laboratory, Faculty of Science (USTTB) Bamako

Abstract: ***The organoleptic characteristics of water consumption explain their acceptability by consumers. The waters of some wells in Nioro are unpleasant to drink, causing the tap water rejection by consumer. The physicochemical characterizations of these waters show that iron and manganese concentrations can reach respectively 1.58$mg.L^{-1}$ and 1.14$mg.L^{-1}$. But the substance indicators of pollution such as nitrogen compounds, nitrites and nitratesions, are not detected (except in NTP water). The unpleasant taste of these waters might be due to Mn (II) ions, which are not eliminated by a simple chlorination.***

Keywords: Characterization, ions, groundwater, manganese, organoleptic

1. Introduction

The town of Nioro (455 km from Bamako in the first region, Republic of Mali) is located on a low ground. It is surrounded by a land shale, sand, clay and gravel. It is crossed by the torrential flowing river "Hagha". For decades, this river that held water for several weeks after each rain along its path in the town of Nioro, no longer holds any today as a result of rainfall declining in upstream and desertification in downstream. The "Hara" of Nioro, green area with its fruit trees and formerly humid throughout the year, is today experiencing severe erosion, carrying whole gardens, since the deepening of the small river passing behind the military barrack in the years 1979-1980. This explains in part why the large diameter wells, which were full before, contain virtually no water today; and tap water which had not an unpleasant flavor, is now almost undrinkable. There have always been wells with an unpleasant water to drink; but their waters were used only for building, cooking, etc. This unpleasant taste may be due to the presence of iron and manganese (metallic and bitter taste) caused by rocks dissolution under carbon dioxide action [1]. It can also be the result of fractional treatment of drinking water or that of organic pollution (domestic sewage, pesticides)[2].

A physicochemical characterization of tap water and well water from the surrounding villages would determine the causes and suggest appropriate treatment. Aeration, biological treatment or a simple chlorination are not sufficient to remove Mn (II) ion concentration below 0.05 $mg.L^{-1}$ (WHO value guide)[3][4]; and the trihalomethane compounds from chlorination might be removed[5]. Major ions, ammonium, nitrite and nitrate ions are analyzed; nitrogenous substances being indicators of pollution. This is the first time water from these villages is characterized.

2. Materials and Methods

2.1 Sampling

Water samples from five villages in the Sahelian belt around Nioro and on four points of that city (Tables 1; 2), were collected in sample bottles.

2.2 Analysis of samples

All samples were analyzed in the analytical chemistry laboratory of the faculty of science (University of Sciences, Techniques and Technologies of Bamako (USTTB)). The parameters such as pH, conductivity, and temperature were determined using a multiparameter. Metal ion concentrations were determined by spectrophotometer of atomic absorption PERKIN ELMER Analyst 200 [6] while nitrogen compounds were analyzed by spectrophotometer of molecular absorption PERKIN ELMER Lambda 40.

3. Results and Discussion

3.1 Results

The test results (Tables 1 and 2 below) demonstrate the presence of manganese in all samples (except in F2) and the absence of the nitrite and nitrate ions. The manganese and the iron concentrations are very high, respectively, in F1 and HNG samples. The concentrations of both ammonium ions and the other metal ions remain low. The pH is that of natural ground waters.

Table 1: Physicochemical characteristics of drinking water from Nioro and five other villages

Parameters	*Units*	*Samples*						
		NR	*NHG*	*NTP*	*DKG*	*BG*	*KG*	*WG*
pH	-	7.5	7.82	7.95	7.17	8.06	8	8.05
Conductivity	($\mu S.cm^{-1}$)	919	214	1487	470	918	536	585
Temperature	(° C)	25	25,7	25	25	25	25	25.7
Na^+	($mg.L^{-1}$)	17.22	10.18	17.76	9.74	17.89	7.14	11.11
Ka^+	($mg.L^{-1}$)	1.17	1.36	3.47	9.06	0.71	0.27	0.13
Mg^{2+}	($mg.L^{-1}$)	7.88	4.35	8.42	7.32	8.37	7.9	8.07
Ca^{2+}	($mg.L^{-1}$)	39.5	2.59	13.33	14.98	10.98	19.63	10.39
Mn^{2+}	($mg.L^{-1}$)	0.37	0.41	0.32	0.53	0.26	0.45	0.09
NH_4^+	($mg.L^{-1}$)	0.0546	0.0816	0.0067	0.0158	0.0149	0.013	0.0235
Fe^{2+}	($mg.L^{-1}$)	-	1.58	-	-	0.11	-	-
NO_2^-	($mg.L^{-1}$)	-	-	-	-	-	-	-
NO_3^-	($mg.L^{-1}$)	-	-	0,1125	-	-	-	-

BG, KG, WG, DKG: wells in four villages; NTP: drilling in one village; HNG: Nioro's well; NR: Tap water from Nioro.; (-): not detected(<0,0001 $mg.L^{-1}$).

Table 2: Manganese concentrations in drinking groundwater from Nioro

Parameter	*F1*	*F2*	*NR*
Mn	1,14	-	0,58

Drilling: F1, F2 (Nioro); Tap water: NR (Nioro)

3.2 Discussion

The aim of this study is to determine the origin of the unpleasant taste of tap water in Nioro. The low concentrations of ammonium ions and the absence of nitrite and nitrate (except NTP) show the presence of carbon dioxide in excess and absence of organic pollution [5] . These results demonstrate that domestic sewage, spraying insecticides, household waste used to fill wells in families, are not the cause of the bitter taste of the water. This is expected because this unpleasant taste existed long before the city population growth. The water of the five villages' wells (BG, KG, WG, DKG and NTG) and drilling F2 whose taste is better than that of tap water, have no iron. The water of F2 which has no manganese is the best of all as F1 water (with 1.14 $mg.L^{-1}$ of manganese) is the most unpleasant to drink (Figure below). If the concentration of Mn (II) ions of tap water is not so high ($0.58 mg.L^{-1}$), it is because it was lowered by the chlorination treatment. So manganese is responsible for the bitter taste of tap water and pushes people to turn to other sources of drinking water. This study also shows that the simple chlorination is not sufficient to lower the levels of manganese in that water below the guide value recommended by world health organization (0.05 $mg.L^{-1}$)[7]. The nonafiltration eliminating water hardness and divalent ions[8][9][10] would be appropriate for the removal of manganese ions in drinking water from Nioro.

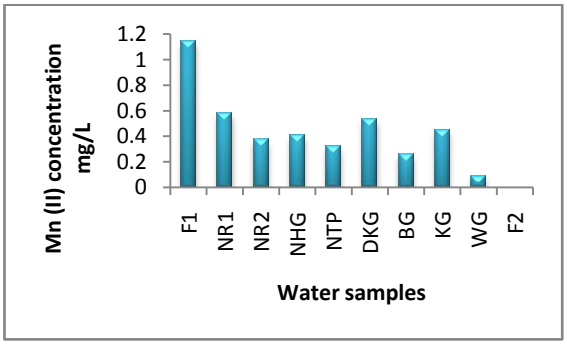

Figure 1: Concentrations of manganese ions in tap water and in water from some wells in Nioro and five villages

4. Conclusion

This study demonstrated that the unpleasant taste of the tap water and water from some wells in Nioro and its five surrounding villages (Republic of Mali) might be due to the presence of manganese whose concentrations can reach 1.14 $mg.L^{-1}$. It also shows that a simple chlorination is not sufficient to eliminate the manganese ions in drinking water. The nonafiltration would be appropriate for the removal of manganese ions in drinking groundwater from Nioro.

References

[1] B. Dumousseau, P. Jaudon, C. Massiani, E. Vacelet et Y. Claire, "Origine du manganèse de la nappe alluviale de Beaucaire (Gard, France), Essai de

démanganisation in situ (procédé Vyredox)", Journal of Water Science, vol. 3, n° 1, pp. 21-36 (1990). DOI: 10.7202/705063ar. http://id.erudit.org/iderudit/705063ar

[2] Jaouad El Asslouj, Sanae Kholtei, Namira El Amrani-Paaza et Abderrauf Hilali, "Impact des activités anthropiques sur la qualité des eaux souterraines de la communauté Mzamza (Chaouia, Maroc) ", Journal of Water Science, vol. 20, n° 3, pp. 309-321 (2007).DOI: 10.7202/016505ar.http://id.erudit.org/iderudit/016505 ar

[3] A Montiel, B. Welte, « Manganese in water. An overview of biological treatment », Revue des sciences de l'eau, vol. 3, pp. 469-481 (1990)

[4] José M. Cerrato, Joseph O. Falkinham III, Andrea M. Dietrich, William R. Knocke, Chad W. Mckinney, Amy Prude, "Manganese-oxidizing and –reducing microorganisms isolated from biofilms in chlorinated drinking water systems", Water Research Vol. 44, Issue 13, pp. 3935-3945 (2010)

[5] Krishna Gopal, Sushree Swarupa Tripathy, Jean Luc Bersillon, Shashi Prabha Dubey, "Chlorination byproducts, their toxico dynamics and removal from drinking water", Journal of Hazardous Materials, Vol. 140, Issues 1–2, pp. 1–6 (2007)

[6] Khay Chuan Teo and Jianrong Chen, "Determination of manganese in water samples by flame atomic absorption spectrometry after cloud point extraction", vol. 126, pp. 534-537 (2001), Doi**:** 10.1039/B008717N

[7] Kwang-Ho Choo, Haebum Lee, Sang-June Choi, "Iron and manganese removal and membrane fouling during UF in conjunction with prechlorination for drinking water treatment", Journal of Membrane Science, Vol. 267, Issues 1–2, pp. 18–26 (2005)

[8] A. Favre-Reguillon, G. Lebuzit, D. Murat, J. Foos, C. Mansour, M. Draye, "Selective removal of dissolved uranium in drinking water by nanofiltration", Water Research, Vol. 42, Issues 4-5, pp. 1160-1166 (2008)

[9] Johan Schaep, Bart Van der Bruggen, Steven Uytterhoeven, Raf Croux, Carlo Vandecasteele, Dirk Wilms, Emmanuel Van Houtte, Frans Vanlerberghe, "Removal of hardness from groundwater by nanofiltration", Desalination, Vol. 119, Issues 1-3, pp. 295-301 (1998)

[10] Fenglian Fu, Qi Wang, "Removal of heavy metal ions from wastewaters: A review", Journal of Environmental Management, Vol. 92, Issue 3, pp. 407-418 (2010), Doi:10.1016/j.jenvman.2010.11.011