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EVALUATION OF NITRATE CONTENT OF 35 WELL WATER OF KOLDA DISCTRICT

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Abstract

Nitrates are not harmful at physiological doses, but bacteria in natural environments and in the oral cavity reduce nitrate to nitrite which harm the human digestive system and are sometimes the cause of stomach cancer and methemoglobinemia in infants. Faced with these alarming findings, the maximum levels of nitrates in drinking water has been set at 50 mg / l (or 8.10-4 mol / l) by the World Health Organization. Given the well water nitrate content, so it has seemed necessary to determine nitrate levels in some samples of well water from the town of Kolda. The assay done with nitrates specific electrode allowed us to know the amount of nitrate in thirty five well water samples from the town of Kolda. The results obtained after averaging showed high levels of nitrates. More than half of the assayed samples had higher nitrate contents in the standard set of 49% having levels below 900 mg / l and 17% exceeding 900 milligrams nitrate per liter. However well water is not the only source of nitrate, we'll also take into account other sources in the monitoring of toxicities occurrence.

Keywords: nitrates - well water - Kolda - electrode

Introduction

Nitrates are physiological human metabolites. Endogenous production is around 1 mg/kg/day or 60 to 70 mg / day in adults. They come mainly from the degradation of nitric oxide (NO) synthesized in endothelial cells from L-arginine by the action of NO synthase [13].

These are not dangerous at physiological doses as long as they are in this form, but bacteria in natural environments and in the oral cavity reduce nitrate to nitrite which harm the human digestive system and are sometimes the cause of stomach cancer. In infants, they cause a decrease in the transport of oxygen through blood causing methemoglobinemia, known as the "blue baby syndrome" (reaction of nitrites with Fe (II) hemoglobin forming methemoglobin , HbFe (III)) [1, 5, 9, 14].

The expansion of the number of groundwater, rivers and lakes polluted by nitrates has become problematic. These, mainly from agricultural activities (use of fertilizers and pig farms), endangering some aquatic ecosystems (eutrophication) and drinking water [4].

Faced with these alarming findings, the maximum levels of nitrates in drinking water has been set at 50 mg / l (or 8.10-4 mol / l) by the World Health Organization [8].

Our study focuses on determining the content of nitrates in well water of the town of Kolda, in order to prevent diseases related to the presence of nitrates in drinking water.

1. MATERIALS AND METHODS

1.1. Materials

Measurements were made with a specific electrode nitrate (MODEL 93-07 laboratory nitrate electrode ORION). This electrode is connected to an ionmeter ref P207 (consort, Belgium), device for measuring the voltage. The study involved 35 well water samples capturing groundwater collected on March 2012. Samples were collected in sterile polyethylene bottles. Calibration curves were plotted with the ORIGIN 7.0 software.

1.2. Methods

The samples were filtered through Millipore membrane using a manual vacuum pump and were stored at 4° C at pH 2 with sulfuric acid to inhibit bacterial activity before dosing. For the measurement of nitrates, the samples are brought back to the laboratory temperature (21 ° C). For each sample, we collected 25 ml and mixed it with 0.5 ml of Reagent TISAB (Total Ionic Strength Adjustment Buffer). We obtain a solution of 25.5 ml whose potential E (mV) is read using the ionmeter stirring (for 3 minutes) and scored after 5 minutes. The amount of nitrates contained in each solution will be calculated from the potential obtained through a calibration curve obtained from standard solutions (F1 to F6) whose concentrations are: 0.00 g / l (F1); 0.03 g / l (F2); 0.06 g / l (F3); 0.11 g / l (F4); 0.22 g / l (F5) and 0.44 g / l (F6).

For each sample, three determinations are then made the average is calculated.

2. RESULTS

Potentials obtained with the standard solutions are shown in Table I. These potentials have allowed tracing with the ORIGIN software 7.0 the calibration curve (Figure 1) from which the samples concentrations of nitrate were determined.

Table I: Potential measured with standard solutions.

	Concentrations (g/l)	Potentials (mV)
F1	0,00	200,0
F2	0,03	157,3
F3	0,06	147,0
F4	0,11	138,7
F5	0,22	128,0
F6	0,44	117,3

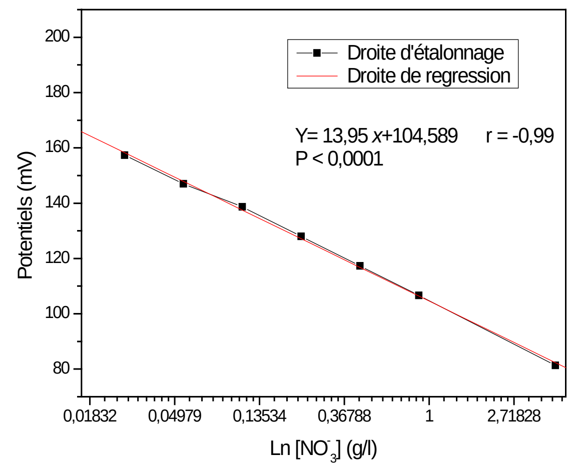

Figure 1: Calibration curve

Potentials E (mV) with samples of well water are shown in Table II.

Table II: Potentials E (mV) measured with samples of well water

N° Wells	1st test E (mV)	2nd test E (mV)	3rd test E (mV)	Mean ± sd E (mV)
W1	179,0	177	178	178,00 ±*1,00*
W2	145,0	144	143	144,00 ±*1,00*
W3	164,0	164	163	163,67 ±*0,58*
W4	112,0	111	110	111,00 ±*1,00*
W5	105,0	106	105	105,33 ±*0,58*
W6	123,0	123	123	123,00 ±*0,00*
W7	122,0	122	122	122,00 ±*0,00*
W8	155,0	157	156	156,00 ±*1,00*
W9	131,0	131	130	130,67 ±*0,58*
W10	153,0	152	152	152,33 ±*0,58*
W11	102,0	101	101	101,33 ±*0,58*
W12	151,0	148	150	149,67 ±*1,53*
W13	120,0	119	119	119,33 ±*0,58*
W14	111,0	111	111	111,00 ±*0,00*
W15	155,0	155	154	154,67 ±*0,58*

W16	**103,0**	**105**	**104**	**104,00 ±*1,00***
W17	**132,0**	**130**	**131**	**131,00 ±*1,00***
W18	**133,0**	**133,0**	**132**	**132,7 ±*0,58***
W19	**167,0**	**168,0**	**167**	**167,3 ±*0,58***
W20	**96,0**	**99,0**	**98**	**97,7 ±*1,53***
W21	**130,0**	**132,0**	**131**	**131,0 ±*1,00***
W22	**111,0**	**114,0**	**113**	**112,7 ±*1,53***
W23	**154,0**	**155,0**	**154**	**154,3 ±*0,58***
W24	**105,0**	**107,0**	**106**	**106,0 ±*1,00***
W25	**105,0**	**104,0**	**104**	**104,3 ±*0,58***
W26	**115,0**	**116,0**	**115**	**115,3 ±*0,58***
W27	**140,0**	**143,0**	**142**	**141,7 ±*1,53***
W28	**127,0**	**127,0**	**126**	**126,7 ±*0,58***
W29	**111,0**	**111,0**	**111**	**111,0 ±*0,00***
W30	**112,0**	**113,0**	**112**	**112,3 ±*0,58***
W31	**155,0**	**155,0**	**155**	**155,0 ±*0,00***
W32	**108,0**	**109,0**	**108**	**108,3 ±*0,58***
W33	**156,0**	**157,0**	**156**	**156,3 ±*0,58***
W34	**120,0**	**120,0**	**119**	**119,7 ±*0,58***
W35	**120,0**	**120,0**	**119**	**119,7 ±*0,58***

Calculation of nitrate concentration (g/l) of each well water is performed using the relationship: $y = a\,x + b$, where:
- It corresponds to the potential E (mV),
- A is the slope (-14.95);
- B is the intercept (104.589 mV).
- $x = \ln\left[NO_3^-\right]$
- $\left[NO_3^-\right]$ corresponds to nitrate concentration.

The average concentrations of nitrate in different wells are shown in the table below (Table III).

Table III: Average nitrate concentrations ([NO 3 g / l]) of different well water.

N° Wells	**E (mV)**	**[NO_3^-] (g/l)**
W1	**178,0**	**0,01**
W2	**144,0**	**0,07**
W3	**163,7**	**0,02**
W4	**111,0**	**0,65**
W5	**105,3**	**0,95**
W6	**123,0**	**0,29**
W7	**122,0**	**0,31**
W8	**156,0**	**0,03**
W9	**130,7**	**0,17**
W10	**152,3**	**0,04**
W11	**101,3**	**1,24**
W12	**149,7**	**0,05**
W13	**119,3**	**0,37**

W14	**111,0**	**0,65**
W15	**154,7**	**0,04**
W16	**104,0**	**1,04**
W17	**131,0**	**0,17**
W18	**132,7**	**0,15**
W19	**167,3**	**0,02**
W20	**97,7**	**1,59**
W21	**131,0**	**0,17**
W22	**112,7**	**0,58**
W23	**154,3**	**0,04**
W24	**106,0**	**0,91**
W25	**104,3**	**1,02**
W26	**115,3**	**0,49**
W27	**141,7**	**0,08**
W28	**126,7**	**0,23**
W29	**111,0**	**0,65**
W30	**112,3**	**0,60**
W31	**155,0**	**0,03**
W32	**108,3**	**0,78**
W33	**156,3**	**0,03**
W34	**119,7**	**0,36**
W35	**119,7**	**0,36**

3. DISCUSSION

The overall analysis of our results shows that only 34% of our samples have nitrate content conform with the standard established by the WHO (50 mg / l). More than half (66%) of measured samples had levels above the nitrate standard established by WHO with grades up to 1.59 g / l like the sample W20. Similar results were also observed with SADEQ et al, whose have shown, for 78 wells measured, nitrate levels higher than 50 mg / l in 69.2% [12].

The samples with relatively high levels of nitrates such as wells W7, W13, W14, W22, W26, W29, W30, W32, W34 and W35 with in grams per liter respectively: 0.31; 0.37; 0.65; 0.58; 0.49; 0.65; 0.60; 0.78; 0.36; 0.36 are collected in urban areas where domestic activities are very diverse. Indeed, these areas suffer from sanitation problems (of illegal rubbish dumps, stagnant water, metals deposits, near the toilets, animal waste) explaining in part the observed values.

Similar results were found by other authors highlighting safety as production source of nitrates in responsible environmental pollution of well water [11].

The wells W11, W16, W20 and W25 have very high grades of up to 1240 mg / l (W11) or 25 times the allowable standard by WHO.

These high nitrate content of well water is explained by the fact that the wells are located in places that may be polluted by nitrates sources namely old growing areas (cotton, rice, other ...); livestock grazing areas. Indeed, nitrates come mainly from fertilizers and organic waste. They are absorbed by the plants during their growth and are for the synthesis of nitrogen compounds. Intensive farming with the use of nitrogen fertilizers are the key generators of nitrates that may contribute to the pollution of water from time to time by ad hoc basis or by diffuse infiltration [2, 6]. Nitrate emissions from agricultural and non-agricultural operations continue to pollute the groundwater around the world [10].

Other factors such as the proximity of sheep, stagnant water and latrines from these wells can explain these nitrates levels observed. Indeed, studies have shown that animal manure and organic waste are real sources of water pollution in nitrate because they are very rich in nitrogenous matter (ammonium nitrate). These nitrates can leach into underground aquifers and contaminate well water [3, 7]. But standing water is a receptacle of water discharges, very rich in nitrogenous material, such as nitrate, which is largely sources of pollution of groundwater by soil infiltration mechanism [3].

CONCLUSION

The expansion of the number of groundwater, rivers and lakes polluted by nitrates has become problematic. These, mainly from agricultural activities (use of fertilizers and pig farms), endangering some aquatic ecosystems (eutrophication) and drinking water. Given these high levels of nitrates in well water of the town of Kolda, it is urgent to set up a water supply system to minimize the risk of pollution. In addition, action should be taken to limit the continuous increase of nitrates in the water. They should focus firstly on waste management and the establishment of sanitation facilities adapted to the socio-economic and geographic context.

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