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PHYSICO-CHEMICAL AND BACTERIOLOGICAL CHARACTERIZATION OF THE RAW WATER OF KONGOU POND (NIAMEY-NIGER)

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ABSTRACT

The present study was conducted at the Kongou Gorou Zarmagandey pool. The aim of this study is to characterize the waters of this pool through in situ and laboratory measurements of certain physico-chemical and bacteriological parameters. The water samples were taken and analyzed according to the standardized methods of some physico-chemical parameters and bacteriological. These parameters are turbidity, pH, conductivity, temperature, iron, organic matter, color, copper, TDS, hardness, calcium, HCO3, magnesium, total residues, TAC, E. coli, faecal Streptococci, total germs and sulpha-reducers. The results showed that the water of the pool study is cloudy and the parameters studied have the following characteristics: turbidity very high (638NTU), the average values of the electrical conductivity of water show that the pool is weakly mineralized (30, 77 µs.cm-1), a significant number of sulpho-reducing bacteria (116 germs per 2 ml); for faecal streptococci, no individual was found in unrefined water, whereas a high content of suspended elements (0.5 mg.l-1) was found and unrefined water contains 1.3 ° F and 15.86 mg.l-1 of bicarbonate. These results found mean otherwise that the water of the pool is of poor quality and is unfit in pressurized irrigation especially drip to drip irrigation. On the one hand, it is desirable to make people aware of the risks of pollution linked to the excessive use of fertilizers and pesticides around the pool. On the other hand, for this water to be used in drip to drip irrigation system, it is necessary to use a filtering device or clarification of water for irrigation.

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INTRODUCTION

The quality of the world's water has in recent years suffered a great deterioration, due to uncontrolled industrial discharges and the intensive use of chemical fertilizers in agriculture. These latest produce a chemical modification of the water and make it unsuitable for the desired uses (Rouabhia *et al*., 2004).Agricultural activities that are practiced throughout the watershed or directly in small plots in the vicinity of the pond contribute to the considerable deterioration of the quality of these surface waters. Moreover, the problem of access to drinking water and Irrigation water with the prospect of drip to drip irrigation is a major challenge for Sahelian countries where people face many difficulties in obtaining water. In recent years, whether it is drinking water or agricultural water, there is some pressure from the populations on the skinny water resources that are often polluted. Due to the large number of living organisms in and around these water points, there are many organic substances, including metabolites. Any pollution of the water creates damage to humans whether by contamination of water and food of aquatic origin or by its environment (Laurence, 1987). Surfaces water and groundwater deserve to be characterized. Kongou Gorou Zarmagandey's pond, eight (8) kilometers long by 400 to 800m, is full of significant unexploited water potential. To do a number of physico-chemical and bacteriological variables were studied: Temperature, pH, conductivity, turbidity, total dissolved solids (T.D.S), calcium, magnesium ... etc. The purpose of this article is to characterize the physico-chemical and bacteriological character of these waters of the said pond for irrigation and / or consumption.

MATERIAL AND METHODS

Material

Study site: The study site is the pool of Kongou Gorou Zarmagandey. It belongs to the urban commune of Niamey IV, it is located northeast of the capital of Niger and covers an area of 9,596 ha. This pool is subdivided into two portions each of which takes the name of the nearest village: Kongou Gorou Zarmagandey pond and Kongou pool.

Methods

Samples of water samples from the pool were made with a clean bottle, rinsed several times with water from the pool with a capacity of 20. Its filling was done to the brim from a can of 5l which was filled by plunging it to an average depth of one meter successively at 2m, 5m, 10 and 15, from the banks of the pool. These samples taken give a composite sample obtained in these four (4) sampling points. After the sample was put in polyethylene vials which once filled were sealed tightly to prevent any gaseous exchange with the atmosphere. The samples placed in the flasks are brought back to the laboratory and kept in the refrigerator at 4 ° C according to the conservation conditions, strictly respected (Rodier, 2009). The following parameters were measured directly in situ using a multi-parameter, it is the T ° C and the pH (then in the Laboratory). The other physico-chemical parameters were determined according to the protocol Analysis of Rodier (2009).

Determination of pH: The pH measurement was carried out using a WTW 315i brand pH meter in three stages: the electrode of the device is soaked in a solution of potassium chloride (KCl) and then rinsed with water distilled water and cleaned with the magnetized bar before immersing it in the sample of water to be examined agitated and stabilized, the value of the pH on the apparatus is noted.

Determination of Electrical Conductivity and Total Dissolved Solid Solids (TDS): The conductivity is expressed in µS.cm-1 and the TDS in mg. 1 and for their measurement, a multi-parameter apparatus with electrode was used as follows: this electrode is first rinsed with distilled water and then immersed in a 100 ml beaker containing the sample of water to be examined, then read on the device after stabilization of conductivity and / or TDS.

Determination of iron: The iron determination was made by takingaway 25 ml of the sample to be analyzed and adding Fer rover. The mixture is allowed to stand for 3 minutes, after which the measurements are made using the spectrophotometer.

Determination of copper: The determination of the copper was carried out as follows: 100 ml of the sample of water to be analyzed in a cuvette. The Porphyrin1 and Porphyries 2 reagents and the Copper Masking Ragent reagent were successively introduced into the sample to be analyzed. Then the copper contained in the two samples was measured using a Dr 6000 Spectrophotometer.

Determination of calcium: Calcium or rather calcium ion was measured by multiplying the calcium content by a coefficient equal to 0.4 (Ca = TCax0.4mg.l-1). However, for the determination of the calcium content, the following method was used: 100 ml of water sample are taken using a graduated flask and then the potassium hydroxide reagent 12N (1 ml) and the CalVer 2 reagent (Calcium indicator). The product gives a violated coloring solution and then with the aid of a pulper, EDTAT is added to the solution of sodium droplet with stirring until reaching a clear blue coloring. Finally, the reading of the amount of EDTA added corresponds to the value of TC a of the sample.

Determination of total hardness and magnesium: The following procedure was adopted to determine the total hardness: a sample of 100ml of water to be analyzed was taken using a graduated flask and the following reagents were added: 2ml of Hardness1 reagent at a pH of 10.1, the Hardness 2 reagent, which is a colored indicator, gives a pink staining solution. Subsequently, with the help of a pulper, EDTAT is added and the sodium drop let stirred until a light blue color is reached. Finally, the quantity of EDTA added is the value of the hardness.Since in practice the total hardness of the water corresponds to its calcium and magnesium hardness, the magnesium level was determined using the following formula:

Magnesium Title (TMg) = Total Hardness (TH) -Title Calcium (TCa) .Then Mg ++ is deduced from the TMg according to the ratio: Mg ++ = TMgx0.243

Determination of the total alkalimetric titer and bicarbonate: The bicarbonate was deduced from the TAC according to the ratio: HCO3- = TACx12.2 mg.l-1.The determination of the TAC was made using a specific device called TITRALINE7000.

Determination of organic matter: For the determination of organic matter, the "permanganate index" test was used. This conventional test aims to approximate the content of organic matter in the water. The test consists in measuring in acid medium the quantity of oxygen used for the reduction of the potassium permanganate by the oxidizable materials contained in a water. During this test, potassium permanganate will be consumed by oxidizable materials.

Determination of total residues: The determination of the total residues was made as follows: the water sample is put into a beaker and allowed to settle for two hours. Paste deposits were observed, recovered and then dried in an oven at 50 ° C for 24 hours and weighed.

Determination of turbidity: The turbidity of the water is caused by suspended matter composed of clay, silt, organic particles, plankton and various other microscopic organisms (CEAEQ, 2016). Turbidity is a measure of relative transparency of the water. It is not a direct measure of suspended solids in water, but rather a general measure of their scattering and light-absorbing effect (JAAG O., 1963). It was determined using a cephalometric turbid meter. This device measures light dispersed by suspended particles at an angle of 90 ° to the incident light beam.

Determination of color: The color is a reference of quality at the level of an irrigation water. The coloration of a water is said to be true or real when it is due to the only dissolved substances, that is to say passing through a filter of porosity equal to 0, 45 microns, it is said apparent when the substances in suspension add their own color (Rodier *et al*., 2009). The

color of the raw water was determined using a Spectrophotometer while taking the color of the distilled water as the reference color. It is expressed in cobalt.

Bacteriological analyzes

The bacteriological analyzes of the raw water of the pond consisted of the determination of Echerichia Coli, Streptococci, total germs and sulpho-reducers. These analyzes were done in several stages:

- Sterilization of Raypa STEAMSTERILIZER brand autoclave jars at 121 ° C for 20 minutes;
- Water intake while rinsing the jars upstream three times with the water of the pond;
- Decant the water in 1L jars and store in a refrigerator (PHARMACEUTICAL REFRIGERATOR) at 4 ° C for 24 hours;
- In seed culture media through a suction shaft of water that passes on the medium and fire to prevent contamination by foreign germs. The volume of the culture medium is 100 ml of water on Terpinol medium for E. coli; 100 ml of water on medium A for Streptococci and 2 ml of water on Meat-Liver agar medium for sulphi-to-reducers.

RESULTS AND DISCUSSION

Results

The table below shows a certain group of parameters of the water analyzed: the pH is slightly higher than 8.5, it is considered basic. The water has a temperature around 25 ° C and is weakly mineralized. Some parameters such as turbidity, organic matter, iron, total germs, sulpho-reducing bacteria and Echerichia packages have high values.

Table 1. Physicochemical and bacteriological parameters of the Kongou Gorou Zarmagandey pond water

Parameter	Average value
pH	8.65
Temperature (° C)	23,3
Electrical conductivity (µs.cm-1)	30,77
Initial rate of dissolved substances (mg / l)	15;21
Iron (mg / l)	1.3
Copper (mg / l)	0.114
Hardness (mg / l)	17,9
Iron(mg/l)	1,3
Copper (mg/l)	0,114
Hardness (mg/l)	17, 9
Full Alcalimetric Title (°F)	1,3
Bicarbonate(mg/l)	15,86
Organic matter (mg/l)	3, 85
Turbidity(NTU)	638
Color(Cobalt)	4202
MES(mg/l)	0, 5
Total germ	132 germs per ml
Streptococci	no germ
Sulfa-reducing bacteria	116 germs per2 ml
Escherichia. package	23 germs per 100 ml

DISCUSSION

Physico-chemical indicators of water quality are often subject to chemical variations that are due to anthropogenic activities that alter water features and affect water quality (Karrouch *et al*., 2009). The pH is a factor that depends on the natural conditions of the environment, such as the nature of the high organic matter content and increases during periods of low water, when the evaporation is quite important (EZZAOUAQ M., 1991). The pH expresses the state of acidity or alkalinity of the water with respect to the logarithmic scale from 0 to 14. In the case of our study area, the pH value is 7.31. This falls within the pH range European and FAO standards which are respectively 6.5 and 8.5; 6.5 and 8.4 especially for irrigation water (FAO, IN Chapman *et al*., 1996). This pool has a pH that tends towards basicity, these results corroborate those of ABN (20015) in Niger where a large part of the waters of the Niger River have pH values between 6.84 and 8.73 in December. The basicity of the waters of the study pond and that of the river would certainly be due to the spills of the household products because these two water resources cross important agglomerations. On the other hand, the results of the present study do not conform to those of Alhou (2007) which concludes that the variations of the pH in the Niger river in Niamey are not important. The temperature of the water is a factor of great ecological importance. It governs the solubility of gases, dissolved salts, the speed of chemical and biochemical reactions, and also acts on the metabolic activity of aquatic organisms (IBGE, 2013, Akatumbila, 2011). The analysis of the results shows that the water temperature is 23.3 ° C. This somewhat high temperature of recorded water is due to the shallow depth of the water which is certainly influenced by the air temperature.

These results corroborate those obtained by Mounjid *et al*. (2014) and Belghiti *et al*. (2013) in Morocco, which found average surface water temperatures of 21.15 ° C and 22.92 ° C in the Merzeg and Sierni wadi stations and 20 ° C and 21.04 ° C in the Moroccan region of Meknes. Finally, the slight temperature differences recorded between the Maghreb pools and the Kongou Gorou pool could be explained by the fact that the latter is located in the sub-equatorial zone with a generally warm climate. Electrical conductivity is a data that allows us to approximate the overall mineralization of the aquatic environment and to monitor its evolution (ABBOUDI Akil *et al*., 2014). In the case of raw water from the Kongou pool, an electrical conductivity of 30.77 µs.cm-1, we note here a weak mineralization of the waters of this resource. Our results are close to those obtained by ABN (2015) in Niamey at the level of the Niger River which found an average mineralization of 76 µS / cm. This observed difference in electrical conductivity of the Kongou water and that of the river would probably be due to the fact that the course crossing several agglomerations is impacted by more intense anthropic activities along its entire length than the pool. Hence the recording of the high rate of EC at the river level (4200km) draining all discharges of urban concentrations crossed compared to the long pool of only 8km. The raw water of the pool contains a low total dissolved solids (TDS) content. Since turbidity indicates the presence of particles suspended in water (organic debris, clays, microscopic organisms, etc.), its increase is related to the concentration of these particles in the pool and the development of microscopic algae. The physico-chemical parameters of the pool water analyzed do not comply with the standards of an irrigation water. We also observed high levels of turbidity (638NTU) and iron (1.3mg / l), the maximum allowed limits for drinking water are (turbidity<5NTU) for turbidity and 0.3mg / l for the iron. Our results are not consistent with those found by the study conducted by the NBA on the Niger River in Niamey in December 2015 which found iron concentrations of 0.0047 to 0.407 mg / l at the same

time (December). These high turbidity levels could be due to the nature of the soils of the watersheds of the pool, which are ferruginous soils. The increase in turbidity levels in these waters is due to the presence of suspended solids. Indeed, turbidity is closely related to MES (Rania *et al*., 2010). The initial magnesium content of the raw water (2, 94 mg / l) is comparable to that found by the NBA (2015) which is 2, 23 mg / l. The bicarbonates and calcium in the raw water of the Kongou pool have respectively 15, 86 and 2.32 mg / l, compared with 89.67 mg / l and 9.56 mg / l, respectively, found by BABAYE (2012) surface water from the Téra dam. The high rates of these two materials recorded at the Tera surface water level are related to the geology of the basement rocks. Hardness of water (TH) is a parameter directly related to the amount of calcium and magnesium in water (Rodier, 1984).

The raw water of the pool water of Kongou Gorou has a hardness of 17,9mg / l. This hardness is relatively weak compared in Mediterranean zone and particularly in Algeria. Indeed, in this country, water from the Seybousse wadi recorded a hardness of 72.80 mg / l (Reggam, 2015). This high value found in Algeria compared to that of Kongou could be explained by the nature of the sedimentary rocks of the wadi catchment. The results of the microbiological analyzes of the raw water of the Kongou Gorou pool show a high microbial load. In the watershed, the population of Kongou Gorou Zarmagandey does not have sanitation equipment, which explains the predominance of fecal germs in the water. In the rainy season, human and animal excrement in this area is carried by runoff into the pond and some of this water polluted by faeces and wastewater is infiltrated into the soil. This explains the presence of pathogenic germs in these waters. The results revealed that the water in the study pond has microorganisms indicating fecal contamination such as E. coli.

Conclusion

The physicochemical characteristics of the waters of the Kongou Gorou pool in Niamey were analyzed by the physicochemical and bacteriological quality parameters: temperature, conductivity, copper, iron, organic matter, total residues, TDS, magnesium, Calcium, pH, Echerichia Coli, Streptococci, Total Sprouts, and Sulfa-Reducers. Compared to European standards, these results reveal the slightly polluted state of the pool. The results of the raw water analysis show that it has a basic pH, a very low EC, but this water has high values of certain parameters such as turbidity, organic matter, iron, copper, germs fecal and total ... etc. This water cannot be intended for human consumption without treatment beforehand to be less used in irrigation especially in drip to drip irrigation. Hence the need to find a way to improve the physicochemical and microbiological quality of the water pond water which would make this water clearer and suitable for drip irrigation. Finally, it should be noted that the discharge of wastewater, namely water from domestic use, the use of fertilizers contribute to increase the pollution rate of the pool. To remedy this situation, it will be necessary very quickly to take measures of protection of the water resources and especially to try to sensitize the population to the dangers incurred in the long term in the use of this water to irrigate their plants or for the consumption. The authors thank the Niger Water Exploitation Company (SEEN) for taking charge of all the analyzes in its reference laboratory and for its flawless technical collaboration.

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