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Analysis of Microbiological and Physicochemical Quality of The Water of Lake Tshombe for its Use for Recreational Purposes (Bathing Water)

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ABSTRACT: The city of Lubumbashi was built on land watered by numerous waterways, particularly rivers. However, these rivers contribute to the beauty of the Lubumbashi landscape and discharge their waters, mostly of poor physicochemical and microbiological quality, into the Kafubu River. All of these rivers are prone to various types of pollution. Lake Tshombe, formerly known as the "Municipal Lake" and artificially created by damming the Lubumbashi River, also serves as a tourist mirror for the city.

This lake, long plagued by increasing eutrophication, is also fed by polluted waters from the Karavia, Kamisepe, Kalubwe and Lake Kipopo rivers and is the focus of this research. We have focused our investigations on a qualitative study of the water in this lake and contributing in some small way to the beautification efforts of the city of Lubumbashi.

At the end of this research which focused on analyzing the water of Lake Tshombe from a physicochemical and microbiological point of view in order to determine whether it can be used without health risk for recreational purposes, we can draw the following conclusion on the quality.

KEYWORDS: Quality, investigation, recreational, swimming

1. INTRODUCTION

Water-related issues make headlines almost daily around the world. In our context, these problems are primarily related to water quality. (Kalaka M.C et al, 2024; WHO, 2014; UNICEF, 2007)

Thus, the city of Lubumbashi was built on land watered by numerous watercourses, notably rivers; however, these rivers contribute to the beauty of the landscape of the city of Lubumbashi and discharge their waters, mostly of poor physicochemical and microbiological quality (Kakoma S2. et al, 2004) into the Kafubu River. All these rivers are subject to various kinds of pollution (Shengo et al (1), 2006, Gazette de Lubumbashi, 2006, Kakoma S3 et al, 2004).

Lake Tshombe, formerly known as “Lac Municipal” and artificially created by damming the Lubumbashi River, also serves as the city's tourist mirror. This lake, which has long suffered from increasing eutrophication, is also fed by polluted water from the Karavia, Kamisepe and Kalubwe rivers, as well as from Lake Kipopo, and is the focus of this research.

Water is essential to all living things.

It is a key factor in the health and reproduction of living organisms. In nature, water is found in a variety of forms, the main ones being atmospheric water, surface water and groundwater. Surface water can be divided into two categories: water from rivers, streams and natural or artificial lakes. (Police de l'eau, 2005)

Surface water comes from the runoff that forms watercourses, as well as from rivers, seas and oceans. Surface waters can contain various types of pollutants. (Koh p.,1969 ,Sagascience, 2007, Mukongo MJ.,1996 and Tambwe M.,2007)

In fact, human and industrial activities generate a great deal of waste, which is the source of surface water pollution. If the environment is not properly cleaned up, these various pollutants can deteriorate the quality of surface water. (BLIFERT C. and PERRAU R.,2001, MURAT M.,1981 and KOWA J.J.,2001)

As mentioned above, water is essential to life, and controlling its quality is vital to its rational use. That's why it must be strictly analyzed to identify any chemical or biological agents it may contain, and their concentrations.

Indeed, as part of the city's beautification, the creation of recreational activities and the promotion of tourism, the authorities of the Haut-Katanga province were keen to create an artificial beach on the shores of Lake Tshombe.

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Faced with the problem of pollution threatening all the water resources (Shengo et al (2), 2007) of our city of Lubumbashi, and driven by the desire to contribute to the well-being of the population and support the efforts of our city's authorities, we wanted to use physicochemical, microbiological and bacteriological analyses to determine the quality of the water in Lake Tshombe, to see if it could be used without health risk for recreational purposes.

II. ENVIRONMENT, MATERIALS AND METHODS

II.1 Environment

Lac Tshombe, formerly known as Lac Municipal, was created on November 9, 1962 by His Excellency Moïs Kapend Tshombe, then President of the Independent State of Katanga, to provide bathing facilities for the indigenous population (Revue du Katanga 1970).

Lake Tshombe is located to the south-west of the city of Lubumbashi, precisely in the commune of Lubumbashi in the Golf district. It is an artificial lake built on the Lubumbashi River and fed by water from Kipopo and the Kalubwe River.

This lake, once one of the beauties of Lubumbashi, has been prey to eutrophication for several years, and has only been restored to its former glory thanks to the commendable efforts of the provincial authorities, who want to turn it into a tourist and recreational area by building an artificial beach on the side of the road coming from the Golf district and opposite the prestigious Karavia Hotel.

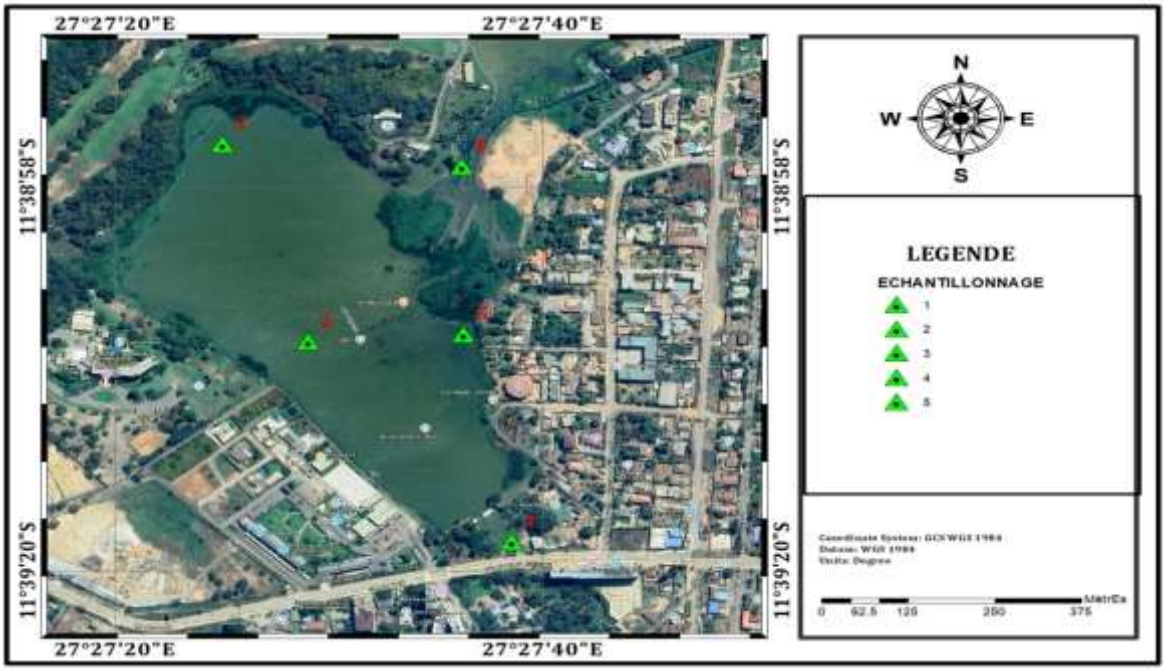

Fig.1 Map of Lake Tshombe and various sampling points

II.2 Method and water sampling

a) Method

As part of our research, we directed our investigations towards a qualitative study of the water in this lake, in order to make a small contribution to the beautification of the city of Lubumbashi.

b) Sampling

We proceeded by water sampling according to a certain number of criteria which we describe below:

- Choice of sampling points

Water sampling was carried out at five randomly selected points to facilitate determination of water quality. Samples were taken at the mixing point of the Lubumbashi and Kalubwe rivers, at the center of Lake Tshombe and in the areas near the Karavia hotel, near the Kalubwe district and after the retaining dam, as shown in figure 1.

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- Sampling procedure

We used a simple method for taking our samples. This consisted in travelling by pirogue to the sampling site, using lightweight equipment consisting of sterile 250 ml polyethylene bottles. The water was taken from the lake by immersing the bottle to the required depth, attached to a specially prepared bamboo cane. A sampling schedule was drawn up, with precise times of day (6 a.m. to 6 p.m.) for seven samplings at each selected point. The seven water samplings yielded five representative samples for each of the points to be analyzed. Two sampling campaigns were carried out, in September 2021 and February 2022. The hermetically sealed samples were kept in a cooler for transport to the laboratory for analysis.

II.3 Materials

We carried out two types of analysis on the lake water sampled:

- Physicochemical analyses: we used the following equipment:
  - ❖ Pipette, pH meter, 100ml flask, spectrometer, flask, aqua regia solution (hydrochloric acid + nitric acid), test tubes, hot plate, water bath and distilled water.
- Biological analysis:
  - ❖ Petri dishes
  - ❖ Blade
  - ❖ Leitz brand microscope
  - ❖ Ibx incubator
  - ❖ Micrometer screw and agar

III. PRESENTATION OF RESULTS AND DISCUSSION

The results of physicochemical and biological analyses of Lake Tshombe water are presented to determine whether it can be used for recreational purposes. These analyses were carried out in September 2021 and February 2022. They relate to the determination of heavy metal concentrations and the kinetic enumeration of pathogens. The results of our investigations will be discussed as they are presented, along with information on the experimental approach we used.

III.1 Determination of mineral element concentrations

Based on 35 water samples of 250ml each, taken from five different locations as shown in Fig. 1, atomic absorption spectrophotometric analysis of mineral element concentrations yielded the results shown in Table I below.

Table I. Concentrations of mineral elements in Lake TSHOMBE water

Analyzed element (mg/L	Water quality standards			Sites for water sampling and analysis				
	A (mg/L)	B (mg/L)	C (mg/L)	1	2	3	4	5
Ag	-	0,5	-	0,001	0,000	0 ,000	0,000	0,000
Cd	0,005	0,2	-	0,002	0,002	0,002	0,002	0,002
Co	-	-	-	0,000	0,000	0,000	0,000	0,000
Cu	1,0	2	1,5	0,000	0,000	0,000	0,000	0,000
Fe	0,3	5	6	0,000	0,000	0,000	0,000	0,000
Mn	0,1	-	0,05	0,000	0,000	0,000	0,000	0,000
Ni	-	2	1,0	0,000	0,000	0,000	0,000	0,000

The results in Table I show that the water in Lake Tshombe does not contain pollution of mineral origin. Indeed, apart from silver and cadmium found in fairly low concentrations (0.001 and 0.002 mg/L), the other mineral pollutants (copper, cobalt, iron, manganese and nickel) were only found in concentrations of 0.000s. Thus, whether based on French standards (OMS, 1994) or the requirements of the Congolese mining regulations applicable to industrial effluents, the water in Lake Tshombe is not polluted, given the concentrations of mineral elements measured. (MFUMU K., 2005)

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III.2 Determination of pH and suspended solids content

Given the results of previous analyses, we were interested in determining pH and suspended solids content. The results of these new analyses are shown in Table II, below.

Table II. Determination of pH and suspended solids (OMS ,1994)

Parameter	Standards*	Sampling and analysis sites				
		1	2	3	4	5
pH	6,5 à 9,5	7,94	7,95	7,95	7,50	7,86
MES	100mg/L	0,016	0,009	0,014	0,026	0,065

The above table shows that Lake Tshombe water has a pH and suspended solids content within the range of values set by the Congolese Mining Regulations. (Journal official de la RDC, 2003)

As for its mineral composition, this water is of acceptable quality up to this stage of our investigations. It cannot therefore pose a pollution problem with harmful implications for the health of recreational users, as it is not loaded with suspensions.

III.3. Microscopic analysis of Lake Tshombe water

From a physicochemical point of view, the water in Lake Tshombe shows no signs of pollution, according to the results obtained during our investigations. In order to determine the microbiological suitability of the water for recreational use, microscopic tests were carried out on five water samples taken at different times of the day (from 6 a.m. to 6 p.m.), using kinetic parasite counts. The results are shown in Table III

Table III: Results of microscopic examinations of Lake Tshombe water

Time (hours)	Results	
	Month of September 2021	***February 2022***
6	No parasites	No parasites
8	No parasites	No parasites
12	Presence of parasites*	Presence of parasites *
15	Presence of parasites*	Presence of parasites*
18	No parasites	No parasites

The most common parasite found in the water is Paramecium Caudatum.

The above table shows that the presence of parasites in the water of Lake Tshombe is a function of temperature, which is one of the factors influencing the growth and proliferation of micro-organisms in a given living environment. For example, in the early morning hours (6 to 8 a.m.) and early evening hours (6 p.m.), parasites were not found in the water, as conditions were unfavorable for their growth and reproduction.

On the other hand, it was during the warmer parts of the day (12 and 15 hours) that parasites were found. These afternoon hours, often the most popular for recreational activities, correspond to peaks in the presence of parasites in the water, and the results obtained are practically the same for the months of September 2021 and February 2022.

The presence of parasites such as Paramecium Caudatum indicates that this water can cause parasitic diseases in users. Our results confirm those obtained by. (Kakoma et al, 2004)

III.4. Bacteriological analysis of Lake Tshombe water

In support of the microscopic examinations of the water mentioned above, bacteriological analyses were carried out on the same water samples and the results obtained are recorded in Table IV, shown below:

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Table IV: Results of bacteriological tests on Lake Thombe water

Time (hour) for sampling	Resultat	
	Month of September 2021	***Month of February 2022***
6	3,000 bacteria*/100ml	2,000 bacteria*/100ml
8	5,000 bacteria*/100ml	3,000 Bacteria*/100ml
12	10,000 bacteria*/100ml	8,000 Bacteria*/100ml
15	66,000 bacteria*/100ml	66,000 Bacteria*/100ml
18	1000 bacteria*/100ml	2,000 Bacteria*/100ml

**Klebsiella pneumoniae pneumoniae*

From a qualitative point of view, these results corroborate those obtained during microscopic examinations of Lake Tshombe water. In fact, bacterial presence in the water intensified and peaked during the hottest hours of the day (from 12 to 3 p.m.), i.e. per 100ml of water the number of bacteria rose from an average of 2,500 to 9,000 from 6 to 12 p.m. and rose to 66,000 from 12 to 3 p.m. for the two selected analysis periods (September 2021 and February 2022). This number fell back to an average of 1,500 in the early evening (6 p.m.). (OMS, 1996)

It should be noted that the presence of these bacteria in water indicates that it is contaminated and can be dangerous for the health of users in that they can cause infections, particularly urinary and ENT infections. (Kamanga w. 2004)

Our results are thus confirmed by those obtained in previous research on water from the Lubumbashi river. (Kakoma et al, 2004) Moreover, the literature indicates that ***Klebsiella pneumoniae pneumoniae*** is a very active bacterium when it reaches a number of 1014 per 100ml of water (Kamanga w., 2004), so much so that one might think, in view of the results of our research, that there is no health risk for potential users of Lake Tshombe water.

In fact, it's true that in-depth epidemiological studies are needed before we can say that Lake Tshombe water is safe for recreational use, since the action of germs on users also depends on the incubation period and other parameters, notably the possibility of absorbing the water by mouth or nose, etc.

CONCLUSION

At the end of this research, which focused on the physicochemical and microbiological analysis of Lake Tshombe water to determine whether it can be used without health risk for recreational purposes, we can draw the following conclusion on water quality.

We therefore suggest that more in-depth microbiological research be carried out, in particular by searching the water of Lake Tshombe for helminths and protozoa, vibrios and other pathogenic micro-organisms or disease vectors such as Simulium damnosum, a small black fly that carries Onchocerciasis (a river blight), whose presence has been reported for some twenty years along the Lubumbashi river and its diversion canal on the stretch between the falls of Lac Municipal Tshombe and the Camp Military Lido.

REFERENCES

1. Kalaka M.C*1., Kayembe K.E2., Nakadime M.T2., Tshimanga E3. Koj M. K. D3., Badibanga K.D4., Ngandu M.C5., Mulungulungu N. D6.,(2024) : Accessibilité et qualité microbiologique des eaux de consommation dans la zone de santé Lubumbashi à Lubumbashi RDC, International Journal of Biological Studies ISSN: 2957-7764 (Online) Vol. 4, Issue No.1, pp 45 - 61, 2024. www.carijournals.org
2. Hôtel de ville de Lubumbashi, (1986) : 1er colloque national sur l'environnement et la pollution industrielle, Lubumbashi.
3. Gazette de Lubumbashi, (2006) : pollution avérée de la rivière Kafubu (Lubumbashi, Kipushi) : mission d'enquête du GANVE et passivité des autorités et axe Lubumbashi-Kipushi : pollution de la rivière Kafubu par les usines des minerais…les plantes et les poissons crèvent, et les populations ? In « dégradation de l'environnement naturel » Journal local d'accès mondial de la ville minière de Lubumbashi WWW.Lubumbashi.info , Septembre 2006.
4. Journal officiel de la République Française, (2006) : Prévention des pollutions et des risques, Arrêté du 30 juin 2006 relatif aux installations de traitements de surfaces soumises à autorisation au titre de la rubrique 2565 de la nomenclature des

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www.ijcsrr.org

installations classées NOR : DEVP06650366A, Ministre de l'écologie et du développement et du développement durable, paris.

5. Journal Officiel de la République Démocratique du Congo, (2003) : Règlement de la république démocratique du Congo, Kinshasa.
6. KAKOMA S.Z. (2004) : l'eau dans la ville de Lubumbashi, Qualité. Approvisionnement et usage. Implication épidémiologiques, Rapport de la 13ième session de recherche de l'observatoire du changement Urbain (O.C.U), Coopération Universitaire au Développement (CUD), Université de Lubumbashi, p.27, 35-39,41.
7. HOCH P. (1969) : Alimentation en eau des agglomérations, 2ème édition, Dunod, Paris.
8. Kowa J.J. (2001) : Etude des possibilités d'épuration des eaux résiduaires de l'usine PAPSI/EXACO, Mémoire de fin d'études, département de chimie Industrielle, Faculté Polytechnique, Université de Lubumbashi, Lubumbashi, p.8,13-16.
9. MFUMU K. (2005) : Paramètres et techniques d'échantillonnage utilisés dans l'analyse de la qualité de l'eau en RDC, Rapport de l'atelier national sur le suivi et l'application des normes sur la qualité de l'eau dans le bassin du Nil, Kinshasa, p.118-120.
10. MUKONGO M.J. (1996) : Contribution à l'avant-projet de traitement des eaux résiduaires de la Brasserie SIMBA en vue de la protection de l'environnement, Mémoire de fin d'études, département de chimie Industrielle, faculté Polytechnique, Université de Lubumbashi, Lubumbashi, p.4-10.
11. MURAT M. (1981) : Valorisation des déchets et sous-produits industriels, 1ère édition, Masson & Cie, Paris, p.6-8.
12. O.M.S,(1985) : Directives de qualité pour l'eau de boisson, Recommandations. Genève, p.129.
13. O.M.S, (1994) : Directives de la qualité de l'eau de boisson, Volume I, 2ième édition Sadog, France, pp.51,61,105-106,136-137,138,141-143.
14. Police de l'eau (2005) : l'eau et la planète, des acteurs mobilisés et des actions concrètes, Ministère de l'Ecologie et du Développement Durable, France.
15. Rath R. (1969) : l'eau, 1ère édition, Dunod, Paris.
16. Revue du Katanga (1970).
17. SAGASCIENCE (2007) : la pollution thermique, Découvrir l'eau, Dossier spécifique : l'eau. CNRS, Source : Sagascience@cnrs-dir.fr
18. SHENGO L. et al (1), (2007) : Etude de la pollution des écosystèmes aquatique à Lubumbashi, cas de la rivière Lubumbashi, Annales du Centre Universitaire de Kamina (Extension de l'UNILU, Vol V, n° 01 , juillet 2007, Presse Universitaire de Lubumbashi, p.76-81.
19. SHENGO L. et al. (2), (2007) : l'eau potable et la pollution des écosystèmes aquatiques à Lubumbashi, cas de rivière Lubumbashi, Communication faite pendant le Colloque Internationale sur la Problématique de l'Eau en R.D.C. (CIPE) : - Gestion durable de la ressource « eau » du bassin du fleuve Congo, Gestion intégrée, sciences, jeux et enjeux géostratégiques du 21ème siècle, Conférence organisée par l'Université de Kinshasa en collaboration avec la REGIDESO avec le soutien du PNUD,MRAC à Kinshasa du 8 au 12 mai 2007.
20. TAMBWE M. (2002) : Problématique de la pollution industrielle dans ville de Lubumbashi, Mémoire de fin d'étude, département de chimie Industrielle, Faculté polytechnique, Université de Lubumbashi, Lubumbashi, p.9-11.

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