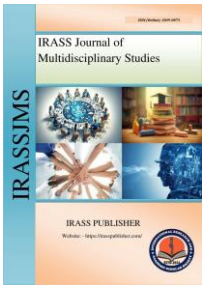
IRASS Journal of Multidisciplinary Studies
Abbriviate Title- IRASS J Mul Stud
ISSN *(Online) 3049-0073*
https://irasspublisher.com/journal-details/IRASSJMS
Vol-2, Iss-1(January-2025)



Determination of Bacteriological Parameters in Raw water and Treated Water of the Environment of Malali Water Works, Kaduna State, Nigeria

Abdulazeez, A.M.[1], Agada, J.[2*], Mohammed, S.A.[3], Saidu, A.[2], Amira, M.K.[3], Idujagi, O.S.[2], Adamu, S.U.[2], Winner, L.[2], Ransom, U.J.[4], Joseph, I.B.[5], Jamila, M.M. [6]

[1] Department of Basic and Applied Sciences, College of Agriculture, Science and Technology, Jalingo, Taraba State, Nigeria

[*2] Department of Biological Sciences, Nigerian Defence Academy, Kaduna State, Nigeria

[3] Department of Biological Sciences, Kaduna State University, Kaduna State, Nigeria

[4] Department of Zoology, Ahmadu Bello University, Zaria, Kaduna State, Nigeria

[5] World Health Organization, Plateau State Office, Nigeria

[6] Department of Biological Sciences, Federal University Kashere, Gombe State, Nigeria

Corresponding Author Agada, J.

Department of Biological Sciences, Nigerian Defence Academy, Kaduna State, Nigeria

Email: jeremiahagada20@gmail.com

Article History

Received: 23 / 12 / 2024

Accepted: 07 / 01 / 2025

Published: 10 / 01 /2025

Abstract: The benefits of portable water are enormous because it is essential for living organism's welfare and healthy living. A large number of over 1 billion individuals has been estimated that they do not have access to useful water and about 2.4 billion the entire population are short of essential sanitation. This study was set out to determine bacteriological parameters of raw and treated water within the premises of Malali water works, Kaduna State, Nigeria. Standard techniques were employed to identify and determine some bacteria associated with water of Malali Water Works, findings were therefore related to permissible limits. The result showed that Coliform was present both in treated water, E. coli, Salmonella, and Pseudomonas were only present in raw water. This implies therefore that there were no bacteria observed in treated water at Malali Water Works, Kaduna State. It can be concluded therefore that treated water from the Malali water works is of better quality than raw and untreated water. Generally, treated water in the area is free of the bacteria checked for. Routine research should be consistently carried out to in Malali Water Works and other places where water is purified for human consumption.

Keywords: Water, Bacteria, physico-chemical parameters, contamination, water pollution, water Purification.

How to Cite: Abdulazeez, A.M., Agada, J., Mohammed, S.A., Saidu, A., Amira, M.K., Idujagi, O.S., Adamu, S.U., Winner, L., Ransom, U.J., Joseph, I.B., Jamila, M.M.,(2025). Determination of Bacteriological Parameters in Raw water and Treated Water of the Environment of Malali Water Works, Kaduna State, Nigeria. *IRASS Journal of Multidisciplinary Studies, 2(1),41-44.*

1.0 Introduction

Water dependence in life cannot be overemphasized, living organisms, environmental systems, anthropological well-being and agricultural activities, water therefore has remained a significant natural resource on earth (1). When water supply decrease, it becomes an underlying substantial predicament of our environment affecting different nations on earth (2).

Raw water are natural water that originates from the environment and has not been processed or purified as well as having minerals, particles, and microorganisms removed. Raw water comprises of ground water, rainwater, water from infiltrated wells, as well as surface water (3). Raw water could be unsafe for drinking by humans due to the presence of possible contaminants. Quality water can be described regarding physical, chemical and biological factors, the act of determining the water quality is paramount to enable usage for purposes such as domestic uses, drinking by animals and humans, agricultural purposes, recreation and industrial uses (4). Water quality is evaluated in the laboratory using techniques to identify the presence and level of contamination. Different pollutants can be identified in water samples based on the parameters investigated (5).

Surface water type is a common freshwater resource for humans, although, it has been observed to be contaminated with heterogeneous discharge from sewage, industrial waste and excess anthropogenic activities influences characteristics that influences both physico-chemical and bacteriological changes (6).

an elementary concern for drinking water to be safe is the possibility of disease transmission through drinking water is and other forms of use. Water pollution by fecal matter and other substances have the tendency to introduce a variety of

pathogens which can result into diseases ranging from mild or moderate gastroenteritis to advance and fatal diseases such as dysentery, cholera, diarrhea, typhoid, hepatitis, giardiasis and a host of other related diseases (7, 8). This research provides update of bacteriological parameters of water in river Kaduna along Malali water works area of Kduna State, Nigeria.

2.0 Materials and Method

2.1 Study area

The research was carried out at Malali water works, Kaduna with coordinates (10^{o} 33' 35" N, 7^{o} 28' 50" E). Malali water works was founded in 1960 and commissioned in 1972. The water works have a total capacity of 270 ML/D.

The water works provide portable water to parts of Kaduna State which include Kaduna town, Malali, Kawo, Anguwan Rimi, Anguwan Dosa, Tudun Wada, Unguwan Sarki, part of Sabo and part of Barnawa.

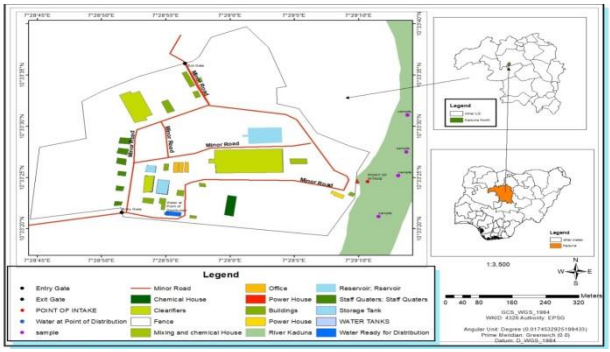


Figure 1. Cadastral map of Malali water works along sampling points

2.2 Water samples collection

Samples of water were collected twice within a month for six months in plastic bottles (1000ml). Different collections were from the River Kaduna at the point of raw water intake into the water works, and treated water at the point of distribution from the water works.

Samples collected at the first point, River (point of intake) were by submerging the sample container into the river between 10 cm –15 cm below the surface with an open end against the direction of current flow as done by (9).

The sample bottles were rinsed with deionized water before collecting the samples and kept in a cool and dry container so as to maintain the temperature and other conditions necessary to keep the physical and chemical properties intact. (10).

2.3 Bacteriological analysis

Bacteriological analysis of samples were carried out in Kaduna Environmental Protection Authority (KEPA) laboratory in Kaduna State.

All the media used for bacteriological analysis of the water samples; MacConkey Broth (MCB), Eosine Methylene Blue Agar (EMB), Salmonella Shigella Agar (SSA) and Cetrimide Agar (CTA) were weighed and prepared according to the manufacturers specification.

The detection of coliform, *E. coli*, ***Pseudomonas aeruginosa*** and *Salmonella spp* were carried out after the work of (11) and compared with (12).

2.4 Data analysis

Data is presented as mean ± standard error of mean (SEM) for each parameter. One way Analysis of Variance (ANOVA) was used to compare mean values; $p \leq 0.05$ was considered to be significant. Duncan multiple range test was used for multiple comparison of significantly differing mean values.

3.0 Results and Discussion

pH of the raw water samples was slightly alkaline, ranging from 6.83±0.05 to 7.68±0.05. The mean temperature of raw water ranged from 20.7±0.12°C to 27.9±0.05°C due to seasonal changes. More so, dissolved oxygen content in raw water ranged from 2.14±0.68 mg/L to 25.4±7.98 mg/L at different times of the year.

Water quality is a measure of certain conditions that are relative to the requirements of biotic species as well as human need or purpose. This is also is defined by its chemical, physical, biological, and radiological characteristics (13). Though potable water is scarce. It has been observed that natural water sources suffer significant amount of pollution to the extent that they have been identified as unfit for the consumption of humans without undergoing a form of treatment process. Human activity has largely influenced water pollution.

The measured range of pH of raw water from this study promotes the survival of aquatic organisms (14). Also, mean temperatures at all times of the year of treated and untreated water were within the WHO and NSDWQ permissible limits. These observations agree with those of (14, 15). Chemical reactions which take place in water depends on temperature and in turn can influence the survival in living organisms including bacteria (16). Dissolved oxygen is essentially required for aquatic organism survival due to the dire need of oxygen to carry out metabolism (17, 18).

Table 3.1 shows the total mean coliform count in raw water was higher than the permissible limits set by both WHO and NSDWQ. These elevated levels of coliforms in raw water may be due to discharge of animals and human fecal matter into the river and tributaries of the rivers. They may also be from the soil of the outlying areas due to surface runoff water, particularly during the rainy season months in which the counts were much higher than in the dry season months (19). According to the (20), total coliform count not a useful index of fecal pathogens. However, it can be used as an indicator of the effectiveness of water treatment process (21). This can be seen in the significant reduction in the total coliform count in treated water samples which was lower than that set by the NSDWQ. Seasonal variations in total coliform counts as observed in raw water must be due to the increased surface runoff water associated with the rainy season months.

Escherichia coli are usually present in very high numbers in human and animal feces. It is rarely found in water in the absence recent of fecal pollution, hence, *Escherichia coli* is considered the most suitable index of fecal contamination. The mean *E. coli* count for raw water samples was indicative of recent fecal contamination of the water sample. The high *E. coli* count observed during the rainy season months may be due to increased inflow of runoff water into the Kaduna River. *E. coli* was not detected in treated water samples. This indicates that water treatment processes at the Malali water works efficiently eliminate this (and probably other) organism from treated water. (20, 22) also reported a decrease in fecal load of treated water samples relative to untreated water samples. They attributed the reduction in bacterial load to the efficiency of the treatment process.

Table 3.1: Microbial load in raw water samples collected at the Malali water works, Kaduna

	Total coliform (cfu/100mL)	*E. coli* (cfu/100mL)	*Salmonella* (cfu/100mL)	*Pseudomonas* (cfu/100mL)
July 2018	2400±0.00^{a}	18.25±8.5^{b}	11.75±1.258^{b}	3.5±0.58^{a}
Aug 2018	2400±0.00^{a}	25±1.63^{a}	11.8±0.95^{b}	3.25±0.5^{a}
Sept 2018	2400±0.00^{a}	29±5.29^{a}	18±1.83^{a}	1.75±0.957^{b}
Jan. 2019	1090±340^{b}	7.75±3.86^{c}	4.25±0.5^{c}	1.25±0.5^{b}
Feb. 2019	920±0.00^{c}	7±1.154^{c}	2.0±0.86^{d}	1.25±0.5^{b}
Mar. 2019	2400±0.00^{a}	7.5±1.0^{c}	1.5±0.58^{cd}	1.5±0.58^{b}
Mean	1688.3±739.5	15.8±9.923	8.458±5.99	2.08±1.10
NSDWQ	10	0	0	0
WHO	0	0	0	0
p value	< 0.0001	< 0.0001	< 0.0001	< 0.0001

Mean values with different superscripts have statistically significant difference ($p < 0.05$)

NSDWQ: Nigerian Standard for Drinking Water Quality

WHO: World Health Organization Drinking Water Quality

Table 3.2 Microbial load in treated water samples collected at the Malali water works, Kaduna

Treated	Total coliform (cfu/100mL)	*E. coli* (cfu/100mL)	*Salmonella* (cfu/100mL)	*Pseudomonas* (cfu/100mL)
July 2018	1.5±1.73	0	0	0
Aug 2018	1.0±1.414	0	0	0
Sept 2018	0.5±0.5773	0	0	0
Jan. 2019	0	0	0	0
Feb. 2019	0.203±0.4065	0	0	0
Mar. 2019	0	0	0	0
Mean	0.5339±1.018	0	0	0
NSDWQ	10	0	0	0
WHO	0	0	0	0
p value	0.2110	-	-	-

Mean values with different superscripts have statistically significant difference ($p < 0.05$)
NSDWQ: Nigerian Standard for Drinking Water Quality
WHO: World Health Organization Drinking Water Quality

Pseudomonas and *Salmonella* were also assayed in raw and treated water. The results indicated the presence of both organisms in raw water samples. The W.H.O and NSDWQ standards stipulate that portable water should be free of *pseudomonas* and *salmonella*. *Pseudomonas* is a common environmental organism found in feces, soil, water and sewage. As indicated in table 3.2 for treated water samples, *pseudomonas* was not detected; they are known to be sensitive to disinfection (20). *Pseudomonas* rarely causes serious illness in healthy individuals. However, in predisposed individuals, pseudomonas infection can cause destructive lesions, septicemia, pulmonary infections etc. Essentially, the presence of pseudomonas in drinking water has great implication in hospital settings where it is responsible for hospital acquired infections. Furthermore, the presence of high number of *pseudomonas* in potable water can affect its taste, odor and turbidity. The results also show that raw water was contaminated with *salmonella*. According to the (20), *salmonella* spp are widely distributed in the environment, and may cause gastroenteritis, bacteremia or septicemia. *Salmonella* is usually spread through the fecal-oral route. Waterborne typhoid outbreaks due to salmonella infection usually have devastating public health implications. In treated water, however, *salmonella* spp were not detected. *Salmonellae* are reported to be sensitive to disinfection, hence their absence in treated water (20). (Table 3.2)

4.0 Conclusions

On the basis of the physiochemical and bacteriological parameters evaluated, treated water at the Malali water works is of better quality than raw untreated water. Generally, treated water is less turbid and of lower bacterial contamination; enteric bacteria were not detected in treated water.

Recommendations

Efforts should be made to increase public awareness on the level of water pollution in raw water especially in the rural areas where water is largely untreated before use. Stringent water quality control measures should be implemented at the Malali Water Works to check the seasonal fluctuations seen in bacteriological parameters.

Acknowledgement

We sincerely appreciate the many contributions of the staff of Malali water works, Kaduna State, Nigeria for granting us access to their facility which in turn made this research a success.

Conflict of interest

All authors declare that there is no area of conflict.

References

1. Ademoroti, C.M. A., (1996). Text Book on 'Standard Methods for Water and Effluents' Analysis, pp 20-54.
2. Anonymous (2002). Department of Water Affairs and Forestry (DWAF). Water Quality Management series guideline document U1.5. In: Guideline for the management of waterborne epidemics, with the emphasis on cholera First Edition..
3. Perth W. A (2016) What is raw water? Vintage road Haulage. http://www.vintageroadhaulage.com.au/faq/what-is-raw-water/
4. Sargaonkar A and Deshpande V (2003) "Development of an Overall Index of Pollution for Surface Water Based on a General Classification Scheme in Indian Context," Environmental Monitoring and Assessment, Vol. 89, No. 1, 2003, pp. 43-67.
5. Agbozu, I. E., Ekweozor, I. K. E. and Opuene, K., (2007). Survey of heavy metals in the catfish synodontis clarias. *International Journal of Environmental Science and Technology*, 4:93-98.
6. Anonymous (2002). Department of Water Affairs and Forestry (DWAF). Water Quality Management series guideline document U1.5. In: Guideline for the management of waterborne epidemics, with the emphasis on cholera First Edition..
7. Anum, S. Geology and mineralization in the Bole-Nangodi Belt northern Ghana. In Proceedings of the 33rd International Geological Congress, Oslo, Norway, 6–14 August 2008.
8. Aloke C., Uzueggu I.E., Ogbu P.N., Ugwuja E.I., Orinya O.F., Obasi I.O. (2019): Comparative assessment of heavy metals in drinking water sources in Abakaliki Local Government Area, Ebonyi State, Nigeria. *African Journal of Environmental Science and Technology*; 13(4): 149-154
9. Odiyo JO, Bapela HM, Mugwedi R, Chimuka L (2005). Metals in environmental media: A study of trace and platinum group metals in Thohoyandou, South Africa. Water SA 2005; 31: 581-8.
10. WHO/UNICEF, (2004). Meeting the MDG Drinking Water and Sanitation: A Mid- Term Assessment of Progress. Geneva: WHO/UNICEF. ISBN 92 4 156278 1.
11. AOAC., (2006). Association of Analytical Chemists, Official Methods of Analysts, 18th Edition.
12. UNICEF., (2002). Official Summary, the State of the World Children, pp 2.
13. Reda A.H. (2016): Physico-Chemical Analysis of Drinking Water Quality of Arbaminch Town. *Journal of Environmental and Analytical Toxicology*; 6: 356. doi:10.4172/2161- 0525.1000356
14. Ekhator O., Opute F.I., Akoma O.C. and Mensah J.K., (2015). Water Quality Assessment of Osse River, Edo State, Nigeria, using Physicochemical Parameters. *BIU Journal of Basic and Applied Sciences*. 1(1): 88 – 102
15. Baharvand S. and Daneshvar M.R.M. (2019): Impact assessment of treating wastewater on the physiochemical variables of environment: a case of Kermanshah wastewater treatment plant in Iran. *Environmental Systems Research*; 8:18 https://doi.org/10.1186/s40068-019-0146-0
16. Jagaba A.H., Kutty S.R.M., Hayder G., Baloo L., Abubakar S., Ghaleb A.A.S., Lawal I.M., Noor A., Umaru I., Almahbashi N.M.Y. (2020): Water quality hazard assessment for hand dug wells in Rafin Zurfi, Bauchi State, Nigeria, Ain Shams Engineering Journal, https://doi.org/10.1016/j.asej.2020.02.004
17. Olayinka O.O., Adedeji H.O., Akinyemi A.A., Oresanya O.J. (2017): Assessment of the Pollution Status of Eleyele Lake, Ibadan, Oyo State, Nigeria. *Journal of Health and Pollution*; 7(15): 51–62
18. Rajeswari A., (2015): Efficiency of effluent treatment plant and assessment of water quality parameters in tannery wastes. *European Journal of Experimental Biology*. 5(8):49-55
19. Shittu, O.B., Olaitan, J.O. and Amusa, T.S. (2008). Physico-Chemical and Bacteriological Analyses of Water Used for Drinking and Swimming Purposes in Abeokuta, Nigeria. *African Journal of Biomedical Research*. 11; 285 – 290
20. Adeniran A., (2018). Assessment of Water Quality in Slum Area Ibadan. *Hydrology Current Research* 9: 296. doi:10.4172/2157-7587.1000296.
21. Bourouache M., Mimouni R., Alla A. A. Hamadi F., El Boulani A., Bihadassen B., (2019). Bacteriological and physicochemical quality of treated wastewater of the Mzar treatment plant. *Applied Water Science*. 9:86 https://doi.org/10.1007/s13201-019-0958-0.
22. Kazaure S.Z., Isa H.A., Mohammed Y., Namadi M.M., (2015): Comparative Analysis of Physicochemical Parameters and Heavy Metals of Public Water Supply in Kaduna Metropolis. *IOSR Journal of Applied Chemistry (IOSR-JAC)*. 8(11): 21-26