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Determination of Physical, Chemical, and Biological Constituents of Domestic Water in Gashua Community in North East, Nigeria

Suleiman Saleh Suleiman
Department of Chemistry and Biochemistry, School of Basic Science and Research, Sharda University, Greater Noida, Uttar Pradesh, India
Email: suleimansalehsuleiman@yahoo.com

Abstract: Humans face grave danger as a result of unfavorable changes in the physical, chemical, and biological properties of air, water, and soil. Water has become highly polluted with various harmful pollutants as a consequence of enhanced human population, modernization, fertilizer use, and man-made activity. Natural water contamination occurs as a result of rock weathering and ground leaching, resource extraction processing, and so on. The quality of drinking water must be inspected at regular intervals because the human population suffers from a variety of water-borne diseases. For example the use of drinking contaminated water. The water-born ability to safe drinking water is an important requirement for preventing and treating diseases and enhancing the quality of life. It is essential to understand the various Physical-chemical specifications used for evaluating the quality of the water, such as color, temperature, acidity, hardness, pH, sulfate, chloride, and alkalinity. Heavy metals such as Pb, Cr, Fe, Ba, Cd, As, and others are of particular concern because they cause chronic toxic effects in aquatic animals. Some process water reports with parameters have been provided for the parameter exploration venture. Regulations for comparing the value of real water samples have also been provided for various physical-chemical boundaries.

Keywords: Biological constraints, Chemical element, Ph, Physical, Substantial metals, Water.

I. Introduction

Water is an essential component of human nutrition, whether it is taken directly or indirectly as a component of food and used for a variety of other purposes. Rapid industrialization, urbanization, and population increase have resulted in high demand for good quality water around the world, putting the resource's worth at risk [1]. The sea, the surface, and the subsurface are the three main sources of naturally occurring water. Water is abundant, covering more than 75% of the earth's surface, and is used in nearly each phase of social life cycle. Its ability is stable in all three states of matter.

The massive mainstream of people in developing states continues to depend on apparent H2O as their main source of liquid, but at the same time, as a waste disposal system. The majority of individuals get access to drinking water from polluted sources, which can lead to epidemics of water-related diseases. Because a considerable portion of the population in developing nations (mostly in Africa) appears to lack access to potable water, they are forced to drink unclean water from a variety of sources, including rivers, reservoirs, wells, rivers, and ground water, for having a drink and other household purposes [2] [3]. The world's water supply is made up of streams and ponds (0.1 percent), inland waters (0.008 percent), soil moisture (0.3 percent), environment (0.00 °C), waterways (0.00 °C), groundwater (0.279 percent), and other composed of the ocean (97.2 percent), glacial and some other ice (2.15 percent) [4].

Water is an important portion of human sustenance, whether it is consumed straight as drinking H2O or incidentally as a component of food and used in a variety of other ways in our everyday lives. Rapid industrialization, urbanization, and population increase have resulted in a strong demand for good quality water for national, recreational, manufacturing, and other details around the world, placing the value of this resource in danger [1]. Surface waters are still the principal source of water and waste disposal for the great majority of people in developing countries. The bulk of this population gets their drinking water from unprotected/or contaminated sources, which can lead to epidemics of floating diseases. Because a considerable portion of the inhabitants in unindustrialized nations (mostly in Africa) lacks access to clean water, forced to drink unprocessed marine from several sources such as rivers, reservoirs, springs, streams, and groundwater for drinking and additional household reasons [2] [3]. Clean drinking water has always been a serious concern, particularly in unindustrialized nations like Nigeria [4].

According to a 2009 Nationwide Bureau of Information estimate, roughly 27% of rural dwellers in Northeast Nigeria rely on sources such as streams, ponds, rivers, dams, and precipitation for their daily requirements due to a absence of fresh water [6] [7]. Water is not only necessary for survival; it is also a major vector for disease transmission and a leading cause of neonatal death in many impoverished countries [8]. Water is contaminated with a variety of harmful chemical elements and microbes, and these pathogenic agents have been connected to a variety of population disorders. In several countries at varying stages of development, the power of water to spread infectious illnesses to large groups of people, resulting in illness, has been well defined [9]. Waterborne diseases such as cholera, diarrhoea, dysentery, and hepatitis kill at least a hundred thousand children and adults each year in these areas of research [10]. According to the WHO, drinking polluted water causes over 80% of diseases in developing countries, while unclean and poor water quality causes about 3.1 percent of deaths [11]. Pawari and Gawande [12] the threat posed by poor water quality has attracted international attention in recent years [13] [14]. The majority of bacteria that thrive in drinking water are heterotrophs, which means they need inorganic nutrients like phosphate, nitrate, and other organic compound [16]. Because phosphorus, as a limiting nutrient, plays such a significant ecological. In environment, it serves as a major element for bacterial activity and is the least abundant mineral in comparison to dioxide [17].

Water quality is a significant subject that ultimately decides groundwater resources and includes physical, chemical, hydrological, and physiological factors of the liquid that the user uses to assess its acceptability [18]. Policymakers will benefit from data on the water quality of specific waterbodies when developing management policies for water pollution prevention. Monitoring is the only way to collect such reliable data on pollution control and environmental cleanup. Water quality monitoring is critical, particularly in some parts of the country, for protecting public health, conserving water resources, and managing freshwater sources, which are the main source of water in rural and some urban areas [19]. Water quality monitoring, on the other hand, becomes critical for detecting problems and establishing solutions to maintain water quality from worsening. The goal of this study was to gather data on the physical, chemical, and living organisms quality of residential waterways, as well as to ascertain whether they were safe for human consumption using water quality.

Water is an important part of the environment because it keeps life on the planet alive. All living organisms require water to survive [1]. Freshwater bodies are essential wetlands in and around human settlements because they are typically man-made semi-natural ecosystems in landscapes that allow for water [2]. The quality of drinking water is really important. Contaminants such as pathogens, viruses, heavy metals, nitrogen, and salt have accumulated as a result of insufficient management of patients of refuse from humans, animals, industrial effluent, residential discharge, and pervasive use of limited water resources, contaminated water [3]. Several cases of kidney failure, typhoid, diarrhea, and other water-borne infections have been reported as a result of contaminated water. Many researchers have reported on their work on water quality evaluation. Contaminated water kills more people than diseases such as AIDS, hepatitis, and high blood pressure [4]. Anthropogenic activities such as agriculture, urbanization, domestic sewage, and other activities in the watershed region degrade water quality [5]. Temperature, turbidity, nutrition, hardness, alkalinity, and dissolved oxygen are only a few of the significant elements that influence the growth of living organisms. The relationship between all hydrological aspects of water, including physical, chemical, and biological properties, is known as water quality. As a result, determining water quality entails examining physical, chemical, biological, and microbiological factors that reflect the ecosystem's biotic and abiotic [6]. The water quality index (WQI) continues to generate a notional number that represents overall water quality at a specialised place and time based on the various liquid quality measures.

The surface water index's goal is to convert water circulation qualitative data in to other detailed information which could be used in general, water quality is represented as an index number, which provides a useful recognition of quality of water for the public or any potential use, as well as carbon emissions downturn and water quality [7]. The current study examines the physical-chemical features of water and calculates a water quality index based on these numerous parameters.

II. Statement of Research Problems (Research Gap)

Gashua Northeast, Nigeria used to have the best water delivery system in the entire region. However, this town is presently amid a calamity. Renal failure has been claiming many lives and placing others at risk. According to the facts gathered, up to 467 cases were registered in medical facilities around Gashua from January to October 2020. Renal failure, serious and deadly, appears to be on the rise, but no available information on their water quality. Why is renal failure increasing? What is the best way to eliminate the heavy metal that originates? The current research aimed to find a possible solution by determining the physical, chemical, and biological properties of water in Gashua, Northeast Nigeria. As a result, this study is required to close the gap.

III. Objective of the Study

The main objectives of the study are to determine the physical, chemical, and biological parameters of domestic water sources in the Gashua. As a result of chronic kidney disease, the community (CKD). Despite being a global public health issue, this threat is rapidly spreading in the Gashua community of

Northeast Nigeria. The main cause of this CKD has yet to be identified, but it is suspected to be due to heavy metals in water; consequently, in this study, the concentration level of cadmium (Cd), lead (Pb), and chromium (Cr) in domestic water were determined from five groundwater sources.

- The discrepancies in physical, chemical, and biological properties across various water sources are measured against a global standard. This will help to address the alarming rise of renal failure.
- The current investigation was prompted by an absence of physical, chemical, and biochemical activity of Gashua residents' home water sources.
- The findings of this study will supplement the limited information available on the physical, chemical, and biological aspects of Gashua residential water.

IV. Significance of the Study

The study result will be important in helping to provide us with reference data on the physical, chemical, and biological parameters of domestic water sources in Community Gashua, Northeast Nigeria.

V. Methodology

A. Material and Method

Within the Gashua community, five (5) sampling sites were chosen at random using the Global Positioning System (GPS). These are sources of my sample such as metropolitan water supply, well water, hand pump, motorize borehole, and shallow water sources. Water samples were collected safely. The samples were obtained in disinfected plastic bottles with a capacity of 1000 ml for chemical analyses, and 100 ml sample size bottles for biological analysis. Water samples collected directly from water pumps or taps after having allowed the water to drain for at least 15 to 20 minutes and were directly maintained in acidified to 1% HNO3.

B. Methodology for Physical and Chemical Analysis

The holding time of the varying factors in the liquid extract was calculated using established procedures that included acceptable quality control measures. Physical and chemical properties were tested utilising standard procedures (water temperature, pH, and conductivity) thermometer was used to measure the water temperature, also pH was measured with a Hanna Instrument meter (Model H19813-6) that had previously been calibrated with buffer solutions, and conductivity was measured with a conductivity meter that had previously been calcium hypochlorite solution was used to adjust the instrument. Water samples were collected in 250/125 ml glass reagent bottles, fixed in the field with Winkler's A (manganous sulphur solution) and Winkler's B (sodium) chemical products, and then transferred to the laboratory for further computation.

C. Bacteriological Analysis

The microbiological analysis included total heterotrophic bacterial count and total coliform using the sequential method and pour plate procedures. The streaking method was used to obtain pure bacterial isolates by sub-culturing a previously conceived plate into a produced sterile plate. 2.4 Membrane separation method for Enterobacter isolation in order to detect E.coli and other coliform bacteria, phenol red indicator purified by adsorption technology was added to the lauryl sulphate broth (LSB) used in the experiment. When compared to LSB containing the impure dye, purified phenol red provided clear visual representation of distinct yellow colonies when regarded against a white backdrop. The colonies remained stable at 25 °C for at least 24 hours under laboratory condition.

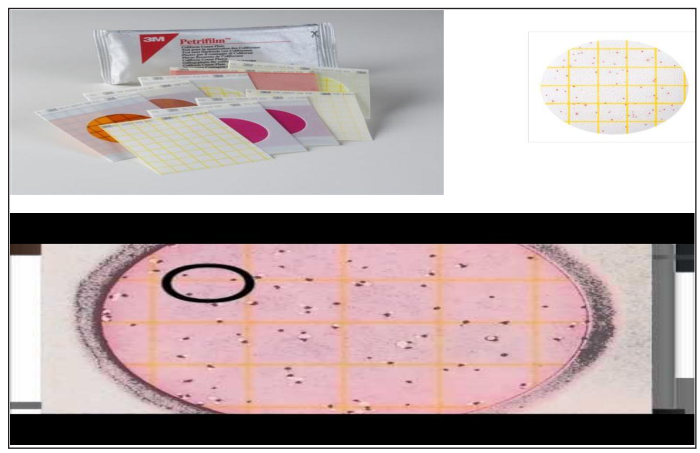

Fig. 1: Images Representing the Fluorogenic Medium Used to Detect Escherichia Coli and Total Coliforms Obtained from Various Sources of Water

VI. Experiments and Results

While carrying out this study I make sure I follow all the accepted protocolsby the world standards that can lead to positive research findings. Care has been taken to ensure that flexibility is carefully managed without unduly compromising the health of the consumers. The tables below (I-III) present the laboratory test findings for the physical, chemical, and biological constituents of the metropolitan water supply, motorized borehole water, and hand pump water of the study area. The result was presented in (Tables I-III).

Table I: Shows the Physical Parameters for Both Metropolitan Water Supply, Motorized Borehole, and Hand Pump Water Sources

Sr. No.	Physical Parameters	Metropolitan Water Supply	Motorize Borehole	Hand Pump Water	Permittable Limit
1	Turbidity	93 FTU	92 FTU	98 FTU	FTU
2	Temperature (°C)	26.27 (°C)	28.17 (°C)	28.23 (°C)	Ambient
3	Color	Colorless	Colorless	Colored	Colorless
4	Taste and odor	Tasteless/odorless	Tasteless/odorless	Soar taste/odor	Tasteless/odorless
5	Total dissolved solids (mg/l)	0.0 ntu	0.0 ntu	0.04 ntu	5 ntu
6	Electrical conductivity (ps/cm)	338	338	338	338 ps/cm

Table II: Shows the Chemical parameters for Both Metropolitan Water Supply, Motorize Borehole, and Hand Pump Borehole Sources

The Constituents Present in Water	Metropolitan Water Supply	Borehole Water Source	Hand Pump Water Source	Health Impact	Permittable Limit
Arsenic (As)	0.010 mg/l	0.011 mg/l	0.014 mg/l	Cancer	0.01 mg/l
Barium (Ba)	0.0 mg/l	0.0 mg/l	0.1 mg/l	Hypertension	0.7 mg/l
Cadmium (Cd)	0.002 mg/l	0.001mg/l	0.04 mg/l	Toxic to the kidney	0.003-0.005 mg/l
Chloride (Cl)	0.05 mg/l	0.63 mg/l	1.05 mg/l	None	2.50 mg/l
Copper (Cu^{+2})	0.05 mg/l	0.02 mg/l	1 mg/l	Gastrointestinal disorder	2.0 mg/l
Fluoride (F^-)	0.20 mg/l	0.45 mg/l	0.45 mg/l	Fluorosis, Skeletal tissue (bones and teeth) morbidity	2.0 mg/l
Iron (Fe^{+2})	0.0 mg/l	0.01 mg/l	0.01 mg/l	None	0.3 mg/l
Lead (Pb)	0.001 mg/l	0.002 mg/l	0.002 mg/l	Cancer, interference with Vitamin D metabolism, toxic to central/peripheral N.S	0.015 mg/l
Ph	7.5	7.8	7.8	None	6.5-8.5
Total Dissolved Solids	500 mg/l	500 mg/l	500 mg/l	None	500 mg/l

Table III: Shows the Microbiological Parameters for Both Metropolitan Water Source, Motorized Borehole, and Hand Pump Water Source

Determination	Metropolitan Water Source	Motorize Borehole	Hand Pump	Health Impact	Maximum Permitted Levels
Total Coliform count	3 cfu/ml	4 cu/ml	15 cfu/ml	Indication of faecal contamination	0-10 cfu/100 ml
Thermo tolerant Coliform or *E.coli*	4 cfu/ml	6 cfu/ml	21 cfu/ml	Utis, bacteremia, leukaemia, diarrhoea (one of the leading causes of morbidity and mortality in children), acute renal failure, and anaemia are all common source of morbidity and mortality	0-10 cfu/100 ml
Faecal Streptococcus	5 cfu/ml	7 cfu/ml	24 cfu/ml	Indication of recent Faecal contamination	0-10 cfu/100 ml

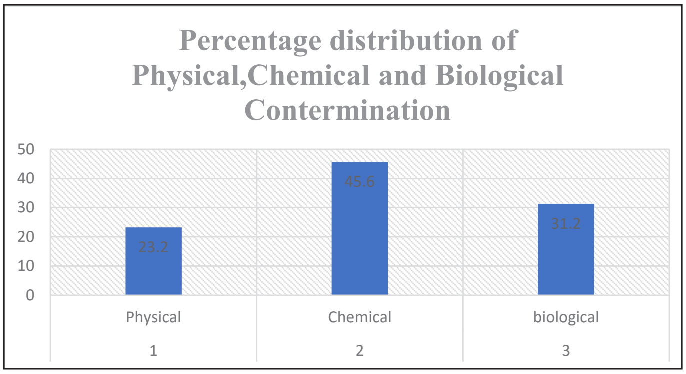

Fig. 2: The Bar Chart Represents the Ratio of Physical, Chemical, and Biological Contamination in the Water Sample

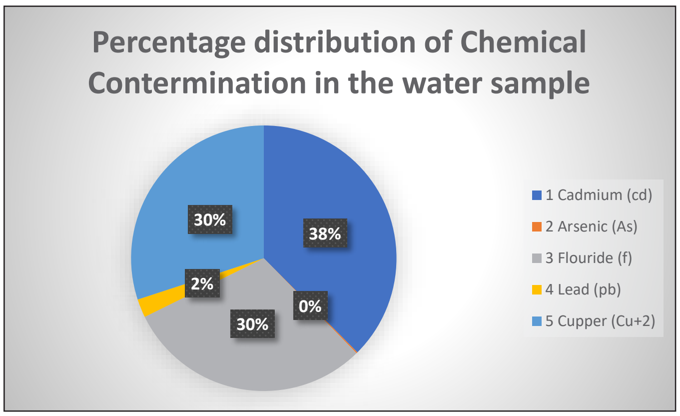

Fig. 3: The Pie Chart Represents the Ratio of Chemical Contamination in the Water Sample

VII. Conclusion

Large urban water supply systems, motorised boreholes, and hand pumps are being promoted as low-cost, low-maintenance systems for delivering treated wastewater in research areas where conventional septic tanks and soil absorption fields fail. According to the findings, multi-species of physical, chemical, and biological contamination are found under climatic conditions found in Gashua, Northeast Nigeria, removing significant amounts of objectionable chemical and microbial pollutants, including some pathogenic bacteria. However, the result shows that the level of contamination of Physical, Chemicals, and Biological were determined for their various contamination ratio as 23.2%, 45.6%, and 31.2% respectively. The discrepancies in physical, chemical, and biological properties across various water sources are measured against a global standard. This will help to address the alarming rise of Kidney renal failure. The current investigation was prompted by a lack of standard water treatment plants in the Gashua community. The findings of this study will supplement the limited information available regarding Gashua residential water sources. Thus, usually contains a high concentration of incoming biological and chemical contaminants which lead to Kidney renal diseases post-treatment need to be employed to supply portable water for consumption and domestic purposes, frequently, a disinfection operation will be required. Furthermore, we observed less efficient removal of some chemical compositions and bacteria of public health importance compared to the global standard. I caution that the observations should be interpreted in light of the fact that predominant water appears to contain high levels of Pb, Cr, Fe, Ba, Cd, and As, and that the study's source contaminant was urban water supply.

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