# Assessment of Physicochemical and Microbial Suitability of Some Selected Surface Water around Ile–Ife Southwest Nigeria for Irrigation

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## ABSTRACT

This study investigated the physicochemical parameters as well as the microbial quality of certain water bodies used for irrigation purposes in Ife East and Ife Central Local Government Areas of Osun State, Nigeria. Physicochemical parameters of samples were measured following standard methods. The identity and population of autochthonous bacteria were determined using standard microbiological methods between November 2018 and March 2019. The physicochemical parameters assessed in the irrigation water samples revealed that pH values of irrigation water sampled falls between $7.06 \pm 0.08$–$8.40 \pm 0.12$, mean value of Total Dissolved Solid (TDS) ranges between $104.00 \pm 1.41$ and $461.3 \pm 1.78$ ppm while temperature was around $31.83 \pm 0.51$°C. Turbidity of the irrigation water sampled exceeded the recommended (<5 NTU) range. Heterotrophic plate count, Total Coliform and Feacal Coliform count were found to be relatively high ($2.80 \pm 0.04$–$7.28 \pm 0.28$ Log10 cfu/ml) and no significant difference (p-values>0.05) was observed in their mean values. A total of 12-13 bacteria species were found in Ife Central and Ife East respectively. These bacteria include *Aeromonas* sp, *Aeromonas hydrophilla Citrobacter* sp, *E coli*; *Enterococcus* sp, *Klebsiella* sp, *Proteus* sp, *Pseudomonas* sp, *Salmonella* sp, *Serratia* sp, *Shigella* sp, *Staphylococcus* sp and *Vibrio* sp. This study concludes that pH and TDS were within the acceptable limits while temperature exceeded the standard in some months. The presence of pathogenic bacteria suggests that irrigation water could be a major source of transmission of waterborne diseases and consequently detrimental to human health.

**Keywords:** Irrigation water; Physicochemical parameters; Microbial quality; Pathogenic bacteria

## INTRODUCTION

Water is a major means of transmission of infectious diseases which is as a result of high pollution level of many water bodies in most developing countries [1]. Pollution of water bodies are attributed to rapid industrialization, urbanization and anthropogenic activities around these water bodies [2-4]. The major contaminants resulting in pollution of water bodies include variety of physical, chemical and biological properties and activities [5]. Millions of people had been reported dead annually as a result of water related diseases which are attributed to lack of portable water and poor sanitation [6].

The process of producing food is closely related to water consumption. Agriculture remains the major area of sustainability that require largest amount of water while agricultural produce play an important role in supplying the essential materials needed for domestic and industrial purposes which are faced with water scarcity in some parts of the World [7]. Irrigation is a vital process practiced by many farmers in order to offset water deficit and increase agricultural produce. However, this practice and its effectiveness to achieving the desired results are highly dependent on availability of good quality water. Several types of water have been reported to be used for irrigation and such water includes surface, ground, rain and waste water which are of diverse microbial quality. In the study areas, traditional irrigation process is the most common a method of irrigation. An example of traditional irrigation method is surface irrigation that requires excess amount of

irrigation water and can lead to surface runoff or introduction of nutrient, microbial rich water into the neighboring environment. Examples of modern ways of irrigation include drip irrigation which is also called trickle irrigation and sprinkler irrigation. In drip irrigation, water is delivered drop by drop near to the roots of plants. Sprinkler irrigation is a process in which water is sprayed by pressurized nozzles into the air and the water particulates then settle down onto the leaves and roots of the crops. Among the aforementioned irrigation methods, flooding and sprinklers would introduce more water to the agricultural produce like vegetables and this will contribute to its level of contamination. Pathogenic bacteria are the most common agents associated with water and foodborne illnesses and consumption of whatever comes in contact with contaminated water represents the major pathway of contracting these pathogens.

A major portion of human diet in many part of the World is made up of vegetables which play an important role in human nutrition as they supply various plant-based nutrients such as minerals, vitamins, fibers as well as phytochemicals which play one or more role in maintaining good health in human. Vegetables are the most common irrigated plants in Nigeria and most of these vegetables are either consumed raw or minimally processed and its contamination poses a serious threat to the health of consumers as well as the handlers. Microbial pollution of the aquatic environment and cross contamination of vegetables may cause gastroenteritis, or affect diverse part of human body. Quite a number of infectious diseases affecting the eye, ear, skin, upper respiratory tract and other parts of the body have been associated with bathing in waters where microbial pollution occurs.

Furthermore, majority of water bodies are exposed to contaminants from various sources which can play a major role in their pollution level. In Nigeria, lack of proper sanitation and efficient waste disposal system as well as waste treatment plants also contribute to the deterioration of water bodies leading to the contamination of anything that comes in contact with the water. Several researchers had reported the incidence of water-borne pathogen in agricultural produce which could play vital role in the qualities of irrigated produce. Literature also revealed that microbial quality of irrigation water impact the microbial safety of irrigated vegetables. To ensure the production of good quality irrigated produce as well as the health safety of the producers, handlers and the consumers of the agricultural produce in the area necessitate this study.

## MATERIALS AND METHODS

### Physicochemical analyses of irrigation water

Irrigation water samples were analyses for physical and chemical water quality properties according in two major ways which are on-site and off-site. The water temperature, pH and Total Dissolved Solids (TDS) were examined at the sampling sites with the use of mercury thermometer (model 275-k), digital pH meter (Hanna instruments, Beijing, China) as well as TDS-meter (Hanna instruments model TDS-02/TDS-03) respectively. Turbidity was measured calorimetrically at 540 nm wavelength.

Parameters measured off-site include Dissolved Oxygen (DO), biological oxygen demand by using standard titrimetric methods.

### Microbiological analyses of collected irrigation water samples

Heterotrophic Plate Count (HPC), Total Coliform (TC) and Feacal Coliform (FC) count of irrigation water samples were determined using standard plate count methods. An aliquot of 1 ml water samples were serially diluted in 9 ml sterile distilled water from 10-1 to 10-6 after which about 0.1 ml of the diluted sample was plated on m-Endo and m-FC using spread plate method for HPC, TC and FC respectively. Plates were incubated at 37°C for 24–48 h. isolates obtained were purified and subjected to standard morphological and biochemical tests for the identification of the bacteria and the tests include catalase, Citrate, oxidase Methyl-red Voges-Proskauert, Motility, Urease, Oxidase, Indole, Ornithin decarboxylase test, Esculin, Lysine decarboxylate test, Gelatin hydrolysis tests, Heamolysis test, Lactose test.

### Statistical analysis

Data obtained were analyzed using Statistical Package for Social Sciences (SPSS) version 20 software and one-way analysis of variance to determine the significant difference in parameters across sampling sites.

## RESULTS

### Physicochemical analysis of irrigation water sampled

The values obtained for physicochemical parameters for the sample analyzed. Ife Central had the highest pH, temperature and BOD in March while highest DO and turbidity were recorded in January with high TDS was recorded in February. The mean values of physicochemical parameters of the samples collected from Ife East had high values for TDS, DO and Turbidity in January, high pH with temperature in March and BOD in February. The pH values of all the collected irrigation water samples fall within the range 7.06 ± 0.08–8.40 ± 0.12 (slightly alkaline) in Ife central while values ranging between 7.20 ± 0.06-7.82 ± 0.02 (slightly above neutral) was obtained from Ife East local government of Osun State. There was no significant difference in pH values obtained in the five months across the sampling sites. The mean value of temperature obtained during sampling in the two areas ranges between 28.66 ± 0.66 and 31.83 ± 0.51°C in which no significant difference was seen in the values obtained monthly in each sampled sites as well as across the sites. The mean values of total dissolved solids obtained ranges between 104.00 ± 1.41 and 461.3 ± 1.78 ppm which was within the acceptable limit. The mean value for dissolved oxygen ranges between 4.15 ± 0.67 to 7.53 ± 0.23 mg/L while the turbidity of the irrigation water sampled were found to be above the recommended range (<5 NTU) with no significant difference.

## Microbiological analysis of irrigation water samples

The mean values of the microbiological variables such as heterotrophic plate count, total coliform and feacal coliform gotten from the two local government areas are shown. The highest mean value for HPC was obtained in irrigation water samples collected from Ife central in March while the lowest was obtained from Ife east in November. Lowest mean value for feacal coliform count was seen in samples collected from Ife East in November, however statistically, no significant difference was observed in the values obtained throughout the sampling period (November-March) as well as across the two local governments. The percentage occurrence of bacterial isolated from the irrigation water samples collected from the two local government areas of Osun state are as shown Figure 1. *Escherichia coli* was found to possess highest percentage of occurrence in both local governments followed by *Aeromonas hydrophilla* and *Enterococcus feacalis* was found in water collected from Ife East which was absent in water samples collected from Ife Central.
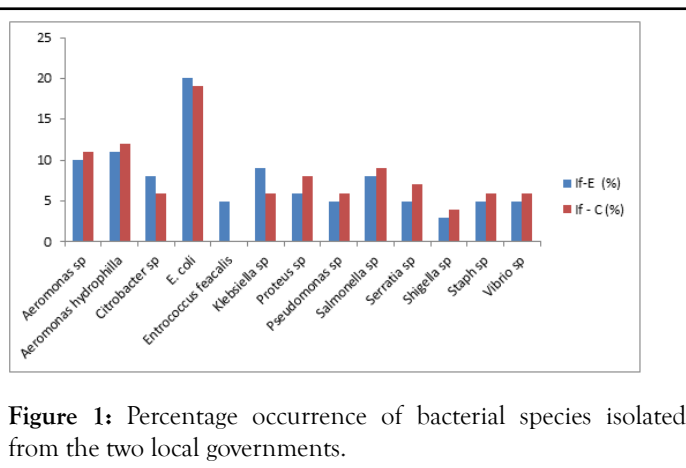


**Figure 1:** Percentage occurrence of bacterial species isolated from the two local governments.

## DISCUSSION

Microorganisms can be found anywhere such as soil, air, water, formites, plant exudates, agricultural produce as well as industrial waste and their survival in such environment is said to be affected various environmental factors. In aquatic environment, factors such as temperature, pH, turbidity, salt concentration and availability of organic matter influence the survival of microorganisms. The mean temperature values obtained in this study ranges from 28.66 ± 0.66 to 31.83 ± 0.51°C and temperature of water bodies affects the biological and chemical activities in the environment which varies with time of the day and season of the year. Generally, temperature of water bodies usually increase during dry season and this was evidence in this study and rate of chemical reactions generally increases at higher temperature. Measurement of the pH determines the level of acidity or alkalinity of the water body. The pH of irrigation water sampled in this study fell within the acceptable limit (6.5–8.5) and changes in pH could be as a result of activities such as surface runoff, respiration, photosynthesis as well as acid rain continuous addition and decomposition of organic materials which could affect the activities of the indigenous microorganisms or decline in their number hence release of essential nutrients. Total dissolved solid in water mainly consist of inorganic minerals and organic matter and

large variety of salts. High TDS means obtained from water samples especially in Ife East that the water may have aesthetic problems, which may be associated with urbanization and anthropogenic activities around the water bodies hence habitat for microorganisms which could pose health threat to the populace. This result agrees with a similar work done in Kebbi state.

Dissolved oxygen is an essential factor in measuring the quality of water as it sustains aerobic life forms. Dissolved oxygen can be influenced by other factors such as temperature and amount of organic matter in the water and these can vary throughout the day. Biological oxygen demand is another important factor in an aquatic environment which could be influenced by the level of pollution of the environment. In this study, mean DO values obtained from Ife central samples were lower compared to that of Ife East but statistically, there was no significant difference in the values obtained. The level of turbidity of a water body is subject to the amount of suspended particles in the water which serve as substrate for biotic life. Domestic effluent discharges and surface run-off from cultivated fields are known to contribute to increased concentrations of ions in surface water leading to high turbidity thereby increasing the number of pathogenic microorganisms like bacteria in the water.

## CONCLUSION

This study investigated the physicochemical and microbial quality of selected surface water used for irrigation purposes. Improper disposal of waste from diverse source as well as anthropogenic activities had deteriorated water quality and this could cause water and foodborne infectious diseases in human. It is therefore recommended that irrigation water should be subjected to some level of water treatment before use so as to prevent the spread of pathogenic bacterial through irrigation.

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