Volume 11, Issue 7, July – 2026 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul321

Identification of Heterotrophic Bacteria and Fungi Associated with Exposed Stagnant Drainage Systems within Gwarinpa Estate, Abuja and Their Effect on the Drainage Surfaces

Anozie, Chinaemelum Immaculata[1]

[1]Veritas University, Abuja

Publication Date: 2026/07/24

Abstract: Biodegradation of organic and inorganic materials and polymers is a complex process of change that occurs with the growth and metabolic activities of organisms. It can be seen in monuments, murals, and scroll artwork. Biodegradation is called "all adverse changes that occur in the material due to the vital functions of the body." Culture extinction is caused by macroorganisms such as animals, plants, and mosses, as well as organisms such as autotrophic or heterotrophic bacteria, microfungi, cyanobacteria, algae, and lichens. To perform the assessment of biodegradation, appropriate structure and properties of biodetergents are often required. Therefore, this study focuses on the causes of destruction of electronic equipment, such as long term exposure location and unstable water. The capacity also includes cleaning of livestock on concrete / stone and isolation of human pathogens from sewers and unsustainable waterlines at Gwarinpa Estate in the Abuja Municipality Area. Samples from drainage sytems in various parts of the region (Chembiam Square, Enoch Square, Gwarinpa II; Fourth Street, Sa'adu Zungur Mansion, etc.) are being collected and analyzed. After performing various culture and biochemical tests on the isolated organisms, it was determined that the water leaving the Gwarinpa Site was contaminated with bacteria such as *E.coli*, *Pseudomonas spp*., *Candida spp*., *Bacillus spp*., and *Staphylococcus aureus*. Based on these findings, it was recommended to dry the drainage syatems to prevent public nuisance. Good hygiene is also recommended to keep the water clean and the drainage system dry at all times to prevent contamination.

How to Cite: Anozie, Chinaemelum Immaculata (2026) Identification of Heterotrophic Bacteria and Fungi Associated with Exposed Stagnant Drainage Systems within Gwarinpa Estate, Abuja and Their Effect on the Drainage Surfaces. *International Journal of Innovative Science and Research Technology*, 11(7), 885-893. https://doi.org/10.38124/ijisrt/26jul321

I. INTRODUCTION

When we think of organisms we should think of them as small but powerful. Diseases are everywhere and greatly affect our daily lives. In addition to recycling our waste and producing the toxins we produce, these invisible creatures also give yoghurt its characteristic flavor; give cake and bread its light, airy beauty; and help us recover from diseases by using it to produce antibiotics like *Penicillium notatum*, *Streptomyces spp.*, etc; as well as aid in plant growth . These diseases not only affect our health, but also the food industry, such as wine and beer production. The impact of the disease on the material cannot be overstated because these effects are clearly visible on our roads, bridges, miles of sewer pipes, water and other structures receiving public treatment. Few people consider the role of microorganisms in the problems we face in the management of our roads and public construction. However, as our analytical methods and molecular techniques improve, we understand that bacteria can cause serious damage to rock. Microorganisms use many substrates as energy and produce many reactive metabolites. These processes are often associated with the degradation of materials considered unsuitable for supporting microbial growth. For example, microbial degradation of prehistoric and renaissance paintings and historic buildings such as cathedrals and monuments (Hvitved *et al*., 2013) is a concern in many countries, these and many more are the problem that brought about the aim of this study; which is, to provide lasting solution to that effect.

- *Concrete*

Concrete is a hard composite material obtained by mixing cement and aggregate (fine and coarse aggregate) with water and combining them with metal bars to form good engineering materials (Sudipta *et al.*, 2012). If constructed and cast correctly, concrete has good compressive properties while steel has good tensile strength, thus proving to be strong and durable. The pH of concrete is very high (initially around 13), which provides a long term alkaline environment that is not corrosive to the metal. However, sometimes the pH of the stone drops for many reasons; which causes corrosion of steel bars (Cayford, 2012). It is one of the strongest building materials used world-wide for centuries.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul321

Concrete buildings are generally considered indestructible because they last longer than most materials. However, they can be destroyed for a variety of reasons, including material limitations, poor design and construction, and serious injuries. Many buildings and other structures undergo biodegradation when exposed to soil, water, sewage, food, agricultural products, and waste (Wei *et a*l., 2013).

➢ *Deteroriation and Biodeteroriation*

- *Deterioration*

Deterioration is a change in the original state of the material due to the interaction of the material and the damaged material (Dakal *et al*., 2012). Deterioration is a serious problem because it reduces the capability, ultimately the ability to perform well; reduces the system's capacity, reliability and life support. Poor performance of the infrastructure is a serious problem as it can shorten the service life and reliability of the system.

✓ *Causes of Deterioration*

- Environmental factors: light, heat, humidity and moisture, dust and soil
- Biological factors: microorganisms, insects and rodents.
- Chemicals such as carbon-oxides, sulfur-oxides, nitrogen-oxides and hydrogen sulfide.
- Human Factor: Unlawful protection, human neglect/treatment, etc.
- Diasters: Flood, pipelines, storm, fire, etc. (Borrego *et al*., 2012).

- *Biodeterioration*

Biodegradation is defined as a negative change that occurs in the material due to the action of biological organisms such as fungi, bacteria, lichens, archaea and pests (Biswas *et al*., 2013). There are many types of diseases and damage. Biomaterials degrade under different environmental conditions, causing various visible changes in the product biomaterial. The ability of microorganisms to degrade biocomposites depends on many factors. One of these is the presence of a metabolic reaction called an enzyme. According to the degradation of biological products; these products can be divided into biophysical degradation, biochemical degradation and aesthetic degradation. Additionally, biophysical or biomechanical degradation refers to the decrease in the physical and mechanical properties of biological materials. This fatigue makes biomaterials weak and brittle (Biswas *et al*., 2013).Many organisms are known to produce cellulose-degrading enzymes to degrade lignocellulose in biomaterial components. Most of these are classified as fungi, while others are bacteria and insects. They occur independently or symbiotically in nature. Those that belong to the class of indirect degraders cannot breakdown lignocellulose. Instead, they are smart enough to invite other lignocellulose-degrading microorganisms to cooperate in the relationship. In general, indirect decomposers provide direct decomposers with factors necessary for survival, for example by producing growth material and preparing the environment for suitable conditions (Joseph *et al*., 2012).

➢ *Concrete Deterioration*

Biologically influenced concrete corrosion is commonly found in foundations and walls and in dams, harbor and offshore structures, bridges, storage tanks, pipelines, cooling towers, silos, etc. also found in buildings. This type of contamination often occurs in food processing and storage areas, as well as slaughter houses and storage buildings, where many organisms such as bacteria, microscopic fungi and algae often grow (Ling *et al*., 2015), which colonizes Pores, capillaries and micro-cracks on the surface of the material damage the stone and cause aesthetic, or functional problems. There are many factors that cause the destruction of stone. The most common are characteristics of the environment (such as saline environment, humidity and carbon dioxide), materials and pouring methods (such as improper construction methods, use of porous mixtures, use of mixed materials from brine, use of salt water), bad vibrations in the concrete, incorrect support, weak performance, use of porous and hairy materials), poor design (e.g. design and detailing, compromise), temperature (e.g. freeze thaw, exposure of stone to hot weather) and improper use (e.g. displacement and loading of structures). There are also chemicals that cause the stone to deteriorate (such as carbonization of the concrete, alkali reaction and sulfate reaction).

➢ *Biodeterioration of Concrete*

Microbially induced concrete degradation (MICD) is commonly found in wastewater such as pipes (Dakal *et al*., 2012). Fresh sewage contains a large number of sulfate ions (SO_4^{2-}), which can be converted to hydrogen sulfide under anaerobic conditions. The bacteria responsible for this change are anaerobic sulfate-reducing bacteria (SRB) and sulfate-reducing bacteria. Desulfovibrio uses sulfate ions as oxygen to assimilate organic matter and releases sulfite ions (S^{2-}) as a byproduct of this assimilation. Depending on the pH and temperature of the wastewater, the sulfite ions present are hydrogen sulfide ions (H^{S-}) or hydrogen sulfide gas (H_2S) (Joseph *et al*., 2012). For example, at pH 7 and 30°C, approximately 60% of the available H2S dissolves as H2S (Joseph *et al*., 2012). In the header above the wastewater, some H_2S reacts with atmospheric oxygen to form sulfur, sulfide, and thiosulfate compounds; these chemicals accumulate on the surface of the rock structure, affecting the digestion of sulfur oxidizing bacteria (Dopson *et al*., 2012).). Sulfur oxidizing organisms (SOBs) convert sulfur compounds into sulfuric acid, which is corrosive and causes rocks to deteriorate. The stone first deteriorates when sulfuric acid reacts with calcium hydroxide in the stone to form gypsum, and then the hydrated calcium in the stone reacts with aluminate to form ettringite (Feng *et al*., 2015). Both gypsum and ettringite swell, causing internal pressure and deformation of the rock matrix. Deterioration is further exacerbated when H_2S gas also enters cracks, reacts with additional concrete, and attacks steel reinforcement (Joseph *et al*., 2012). The biodegradability of many mineral products, especially rocks, often depends on the presence of many carbonates, inorganic sulfur compounds and other substances of abiotic or biotic nature. Their interactions with minerals play an important role in the formation and process of corrosion. It should be noted that concrete is a heterogeneous

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul321

material that generally includes Portland cement, aggregates (coarse and fine), water and selected admixtures. The two main phases of rock, aggregate (59-75% of the rock volume) and fossil (25-40% of the rock), show different properties. However, many physical, chemical and chemical factors can affect the deterioration of concrete and composites (Gonzalez *et al*., 2012). Physical characteristics can be internal or external. This damage is usually caused by a combination of poor quality and improper maintenance. Frost and temperature are among the many physical factors that often affect stone deterioration. Evaporation of water in the cement slurry causes pores to form, allowing water and corrosive substances such as Cl^-, NO^{3-}, SO_4^{2-} and CO_3^{2-} to enter. Additionally, some bacteria grow on the rock surface and secrete extracellular polymers in their pores, changing the porosity and permeability of the rock. When porous rock is exposed to water or saturated soil, the water table extends to the surface of the material and various ions can enter the rock (Gonzalez *et al*., 2012).

The role of bacteria in concrete is mainly related to the sulfur and/or nitrogen cycle, where the weak chemicals, SO_4^{2-} and nitrates (NO^{3-}) are produced during microbial metabolism. Among these processes, sulfate reduction followed by oxidation and nitrification are important reactions. Biodegradation of concrete is mainly due to the metabolic activity of sulfate oxidizing bacteria (SOB) belonging to the Thiobacillus and Thiobacillus genera, especially *Thiobacillus thiooxidans* species [formerly *Thiobacillus thiooxidans*]. Other bacteria include: sulfate-SRB-reducing bacteria in the genus *Desulfovibrio*, *Desulfococcus*, *Desulfomonas*, *Desulfobacter*, *Desulfobulbus*, *Desulfonema*, *Desulfosarcina*, *Desulfobacterium*, *Desulfotomaculum and Thermodesulfobacterium desulfotomaculum*; then fungi [*Coniphoraputeana* and *Serpulalacrymans*] (Yousefi *et al*., 2014).

➢ *Concrete Biodeterioration Mechanisms*

Microorganisms must be present everywhere, on the surface of the material, in the space between the materials, or within the material. Sometimes even a small amount of bacteria on the material is enough to cause microbial damage. In general, their metabolic end products are responsible for stone degradation (Giebson *et al*., 2017). The two main inorganic acids produced by bacteria as metabolic end products are:

- Sulfuric acid produced by sulfur oxidizing bacteria and
- Acid produced by nitrifying bacteria.

In the process of oxidizing different sulfur species in the environment to sulfuric acid, the exact mechanisms used by bacteria depend on the abundant species (Joseph *et al*., 2012). The various methods are:

✓ *Production of Bioorganic Acids*

Most stone-damaging bioorganic acids come from acids or acid-producing substances such as silage, fruit juice, yoghurt and animal waste. Stone corrosion of bioorganic acids resulting from the reaction of cement slurry consisting of calcium hydroxide and carbonates with its contents. The main effect of any type of acid on concrete is the disintegration of the cement paste matrix. Fermenting microorganisms release many organic acids into the environment, including lactic acid, acetic acid, and butyric acid (Heisig *et al*., 2016). The corrosiveness of these acids depends on their type and strength. The effect of bioorganic acids on the biodegradability of concrete depends on the type of cement and aggregate (Yuan *et al*., 2015).

✓ *Biological Carbon-Dioxide Production*

The corrosive nature of water and wetlands may be due to the presence of aggressive carbon- dioxide (CO_2), which can originate (among other things) from biochemical processes carried out by many (micro) organisms present in these environments (Glinicki *et al*., 2016). The lower the hardness of the water, the more corrosive it is. The concentration of carbon-dioxide in water percolating into the soil increases; causing a weak acid reaction due to the formation of carbonic acid. This acid causes calcium hydroxide to form water-soluble calcium bicarbonate Ca $(HCO_3)_2$, which is easily separated from the stone. Even if the CO_2 concentration increases in compressed rocks, this effect is not significant because water absorption is slower than in older rocks (Rajabipour *et al*., 2015).

✓ *Production of Biological Products Nitric Acid*

The presence of toxic ammonia in the aquatic environment may cause corrosion due to nitric acid. Ammonifying bacteria (urine bacteria) break down urea and produce ammonia. Bacteria belonging to the genera *Nitrosomonas*, *Nitrococcus*, *Nitrospira*, and *Nitrosolobus* oxidize ammonia to nitrite, which is then oxidized to nitric acid by *Nitrobacter* and *Nitrococcus*. This acid causes calcium compound in the cement slurry to form water-soluble calcium nitrate, which can be easily rinsed from the concrete structure (Jiang *et al*., 2013). Studies have shown that nitric acid produced by nitrifying bacteria can cause serious damage to household appliances. Many nitrifying organisms are found in both historical sandstone buildings and modern stone buildings (Jiang *et al*., 2013).

✓ *Biological Hydrogen Sulfide and Sulfuric Acid Production*

Biological hydrogen sulfide (H_2S) is the final metabolite of SRB in the anaerobic environment of soil, sewage, and wastewater. The presence of H_2S and sulfuric acid is often the cause of corrosion in concrete pipes where ventilation is inadequate and wastewater is scarce (Joseph *et al*., 2012). This is necessary for the development of SRB in mucus, especially in the lower layer. Sulfur-reducing bacteria (SRB) metabolic activity produces H_2S, which is then oxidized to sulfuric acid by Sulfur- oxidizing bacteria [SOB] (Dopson *et al*., 2012). The concentration of organic sulfuric acid in the stone pore solution can be as high as 10%, corresponding to a pH of less than 1.0. In some cases, the pH of the pore solution drops to as low as 0.6 due to microbial attack, even though the initial alkalinity is as high as 13. Sulfuric acid causes sulfate attack on the cement slurry, leading to the formation of ettringite $(CaO)_6 (Al_2O_3) (SO_3)_3. 32H_2O$ (known as Candlot's salt), sometimes also called

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul321

thaumasite $CaSiO_3$. $CaCO_3$. $CaSO_4.15H_2O$ (Feng *et al*. 2015). During the crystallization process, these salts expand their volume to approximately twice the initial matrix volume. It causes the stone to expand, causing it to crack and break.

➢ *Concrete Biodeterioration Prevention Methods*

The best way to prevent or control biocorrosion is to ensure cleanliness; cleaning removes biofilm and corrosive debris from the surface. Increasing the amount of liquid or adding explosives may result in removal of chemical or bacterial particles and therefore inadequate cleaning of materials. Different methods have been proposed to prevent and control harmful biological diseases: chemicals or antibiotics, additives, biocide treatments and effective biofilm techniques (Gomez-Alvarez *et al*., 2012). This process prevents or inhibits sulfide production by preventing poisoning and preventing anaerobic conditions (suppurative conditions) or providing a protective layer that prevents surface contact with corrosive solutions. Its management includes:

- *Chemical or Antimicrobial Coating:*

Chemical treatment is a way to prevent all types of corrosion; therefore, it may also help reduce Microbiologically Influenced Concrete Deterioration (MICD). The process is performed with non-toxic materials such as silicones, epoxy resins, and fluorinated compounds (Wei *et al*., 2013). Coatings are an effective way to prevent MICD; however, any inconsistency in the system (such as cracks, defects, etc.) becomes the preferred path of localized degradation. The concrete process in wastewater and water treatment must be resistant to the ingress of other wastewater, including H_2S and sulfuric acid. It should also not release corrosive chemicals or be replaced by antibacterial agents [biocides] (Huber *et al*., 2014). Biocides are inorganic oxidizing agents such as chlorine, ozone and bromine, or organic non-oxidizing agents such as isothiazolones, quarternary ammonium compounds, and aldehydes. The efficiency of a biocide depends on the nature of microorganisms being treated and environmental conditions. The combination of oxidizing and non-oxidizing biocides or two non-oxidizing biocides may be used to increase the efficiency of the biocide treatment. Non-oxidizing biocides are more effective to control bacteria, algae and fungi (Gomez-Alvarez *et al*., 2012). Oxidizing biocides are less persistent because of their dependence to pH of solution. Commonly used biocides have the following properties:

✓ Very effective against many pathogens.
✓ Ability to penetrate and break down microbial sludge.
✓ Other properties (such as corrosion inhibitors) and effectiveness with chemicals in the environment (such as corrosion inhibitors) and pH effect physical compatibility).
✓ Storage Safety and ease of use.
✓ Reasonable biodegradability
✓ Cost effectiveness (Gomez-Alvarez *et al*., 2012).

- *Use of Admixtures and Cementitious Additives in Concrete*

Another way to prevent MCID is the use of admixtures (e.g. polymers, antibiotics) and additional cementitious materials (e.g. silica fume, fly ash) (Sudipta, *et al*. 2014), 2012). The prevention method is to prevent SOB adhesion by reducing the permeability of the stone or increasing the chemical resistance of the stone (Wei *et al*., 2013). Adding silica fume or fly ash not only reduces the permeability and spread ability of concrete, but also reduces the free calcium hydroxide content in concrete, reducing the expansion reaction (Giebson *et al*., 2017). The addition of polymers increases the performance of concrete against sulfuric acid by preventing the formation of large stones due to the interaction of cement hydrates with the polymer (Huber *et al*., 2014). The addition of styrene acrylate in polymers has been shown to be more effective in reducing weight, pH and calcium accumulation (George *et al*., 2012).

- *Add Nitrate or Nitrite*

Removing sulfate from water or adding thermodynamically favorable compounds such as oxygen, nitrate, or nitrite can prevent anaerobic conditions and sulfate reduction (Jiang *et al*., 2013). Nitrate, due to its higher oxidizing properties, can remove more oxidizable species than nitrite. In anaerobic reactors, nitrate or nitrites as oxidants are preferentially reduced, eliminating the production of hydrogen sulfide (Jiang *et al*. 2013). Nitrate- or nitrite-reducing, sulfite-oxidizing organisms (NR-SOB) use nitrate or nitrite to reoxidize sulfites, leading to sulfur and sulfate. Nitrite can also inhibit the assimilation of sulfite to sulfur by sulfite reductase. Investigation on the effectiveness of adding nitrate to plant wastewater by adding calcium nitrate (Nutriox) at the inlet, both in the initial wastewater discharge, initial sedimentation, and final wastewater, and examining the water quality before sand removal was carried out in the past (Jiang *et al*., 2013). Reductions in sulfur were observed in air and water; the highest reductions were 98.7% and 94.7%, respectively. The decrease in sulfur concentration is due to the activity of nitrate-reducing sulfur-oxidizing bacteria, which can oxidize sulfur only in the presence of nitrate. This protection mechanism for biodegradation of concrete depends on 3 factors:

✓ The type of organism present
✓ The type of environment present on the site and
✓ The degree of damage that has occurred. (Ling, 2013).

II. MATERIALS & METHODS

➢ *Study Area*

The study was conducted at Gwarinpa Estate in Abuja, Nigeria. The distance between the laboratory and the research area (Gwarinpa) is 25.7 kilometers.

➢ *Study Population*

The target population of this study is the regulated water bodies in Gwarinpa Site.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul321

➢ *Study Design*

The research design includes experiments that produce quantitative and qualitative data. Ten sample points (exposed stagnant drainage system) were selected as samples. Five stagnant water samples (10 ml each) were collected from 5 sampling points; then, the remaining 5 samples (1 g each) from the side of the pipe were also collected from 5 other sample points for microbial analysis. Good information was obtained by investigations, biochemical confirmation and microscopic verification of relevant tests. Data for identification of organisms in each sample are quantitative.

- *The Medium Used in this Study*

The medium used for the isolation of bacteria are Thiobacillus agar medium, Thiobacillus broth medium, postgate-b medium, nutrient agar (HiMedia), MacConkey agar (Hi Media) and Potato dextrose agar was used to isolate the fungal isolates. Prepare culture medium according to the manufacturer's instructions.

- *Chemistry/Reagents*

Reagents used in this study include: Gram stain reagents (gentian violet, iodine, acetone, and safranin), hydrogen peroxide, and Kovac's reagent.

- *Glassware/Equipment Used*

These include: microscopes, autoclaves, petri dishes, Erlenmeyer flasks, metal rings, glass slides, test tubes, Bunsen burners, incubators, hot air ovens, glass and rubber pipettes, refrigerators, graduated cylinders, sterile Containers, anaerobic jar and anaerobic gas bags, McCartney bottles, weighing balance and beakers.

- *Sterilization of Materials*

All glass used is washed, dried and sterilized in a hot oven. Sterilized at 1600°C for 1 hour. Clean the work area (chair) with cotton and 70% alcohol. Wire rings are flame sterilized before and after use.

- *Sample Collection*

Using sterile tubes, 10 ml of stagnant water was collected from sample contents for each of 5 samples and pour into sterile and labeled macCartney bottles for easy checking. Using a sterile spoon, 1 gram of each of 5 samples was collected and added to 10 ml protein water (transport medium). These samples (water and solids) are collected periodically; after each collection period, the scraper used to collect the scraps was removed from the remainder of the waste sample. After each collection period, any remaining water in the container used to collect stagnant water was wiped off. The collected samples (stagnant water and scrapings) were placed in sterile buckets and transported to the microbiology laboratory.

- *Sample Cultivation and Isolation*

Microbial isolation was carried out using Thiobacillus medium, Thiobacillus agar, postgate-b medium and potato dextrose agar (PDA). Separation was carried out to separate the organisms in each stagnant water sample; 1 ml of water, e.g. 1:10 dilution (for isolation of sulfur oxidizing bacteria), was placed in 9 ml of Thiobacillus broth medium; inoculated Thiobacillus Broth was placed in a 30 °C incubator for 7 days and the presence of turbidity indicates proliferation of bacteria, followed by subsequent separation of Thiobacillus agar for identification (Behera *et al*., 2014). Then, 1 ml of water was inoculated into 9 ml of postgate-B medium to isolate sulfur-reducing bacteria. The inoculated postgate B culture medium is cultured in an anaerobic tank (containing an anaerobic gas bag) for 7 days. After 7 days, bacteria were identified (Ghazy *et al*., 2011). MacConkey agar was also used to isolate bacteria of health importance; using plate method, incubated for 24 hours and then subcultured to new media using the streaking method to obtain separate colonies. Plates were incubated for 24 hours before further microbial identification.

For the fungal isolates, 1 ml of waste material was inoculated into 9 ml of protein water (diluted 1:10). Protein-free water was incubated for 48 hours; then, using the plate method, 0.1 ml was placed on potato dextrose agar medium for 48 hours. It was then subcultured into a new prepared PDA plate by streaking to obtain discrete colonies. Further identification of the organisms was made. (Nath *et al*., 2015).

The presence of sulfur oxidizing bacteria was determined by the formation of small sulfur-soaked colonies with clear areas after 7 days; this indicates that acid was produced via thiosulfate oxidation during culture on Thiobacillus agar after incubation, but if these specified properties are not present it indicates absence .

Further identification was carried out by subculturing from tubes containing turbid postgate-B medium onto nutrient agar plates (for bacterial isolation) and potato dextrose agar (for fungal isolation), respectively.

- *Biochemical Identification and Characterization of Organisms*

The biochemical characteristics of the organisms were identified and characterized by carrying out different biochemical tests such as catalase, Coagulase, Citrate, Urease, Methyl-red, Voges-proskauer, Indole, Motility, Spore-forming and Carbohydrates fermentation tests (glucose, sucrose, lactose etc.). The results are recorded after the examination.

- *Identification of Fungi (Yeast)*

Fungi (yeast) isolated from samples were identified through germ tube test. Germ tube test: is a screening test which is used to differentiate *Candida albicans* from other yeast.

Germ tube (GT) formation was first reported by Reynolds and Braude in 1956. Principle: Formation of germ tube is associated with increased synthesis of protein and ribonucleic acid. Germ Tube solutions contains tryptic soy broth and fetal bovine serum, essential nutrients for protein synthesis. It is lyophilized for stability. Germ tube is one of the virulence factors of *Candida albicans*. This is a rapid test for the presumptive identification of *Candida albicans*.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul321

Procedure: 0.5 ml of human serum was added to the vial. A yeast colony was obtained using a Pasteur pipette and slowly emulsified in the blood. The tubes were incubated at 37°C for 2 to 4 hours. Then transferred the serum to the glass slide for examination; a cover slip was applied and the microscopic examinations was performed under low and high magnification objectives. Appearance of short hyphae (filaments) that are later attached by the yeast cell, initially without constriction; then a germ tube that is half the width of the yeast and 3 to 4 times the size of the yeast, with no presence of nucleus indicate positive result. For example: In *Candida albicans* etc. Thus, the result is negative if there is no hyphal (filamentous) extension or if there is no short hyphal extension that contracts at the beginning of the yeast cells. Example, found in *Candida tropicalis* etc. (Atalay *et al*., 2017).

III. RESULTS

The microorganisms identified from the scrapings and the stagnant water gotten from exposed stagnant drainage system in Gwarinpa district ,Abuja are presented below after carrying out various test to determine the cultural and biochemical test of the isolates. It will be seen from the several tables below that the isolated organisms include *Pseudomonas spp*, *Bacillus spp*, *Staphylococcus aureus*, and *Escherichia coli*; while the fungi isolate include *Candida spp*.

➢ *Isolation of Bacteria*

Table 1 Cultural and Morphological Characteristics of Bacteria in the Stagnant Water

Suspected isolates	Morphology	Microscopic
Bacillus spp	White- creamy flat with rough edges	Gram-positive bacilli with spores
Pseudomonas spp	Greenish-blue low convex with smooth edges	Gram-negative bacilli
Staphylococcus aureus	Golden-yellow convex with smooth edges	Gram-positive cocci in cluster
Escherichia coli	Pinkish flat with smooth edges	Gram-negative bacilli

Table 2 Biochemical Result of the Stagnant Water Subcultured in Nutrient Agar Plate from Postgate-B Medium with Growth.

Samples	Gram reaction	Catalase	Coagulase	motility	Spore test	citrate	Urease	indole	Methyl red test	Lactose	Sucrose	Glucose	Identified organism
Sample 1	+R	P	-	P	P	P	N	N	N	N	P	P	*Bacillus spp*
Sample 2	+R	P	-	P	P	P	N	N	N	N	P	P	*Bacillus spp*
Sample 3	+R	P	P	N	-	P	P	N	P	P	P	P	*Staphylococcus aureus*
Sample 4	+R	P	-	N	P	-	N	P	-	N	P	P	*Bacillus spp*
Sample 5	-R	P	N	P	-	P	N	N	N	N	N	N	*Pseudomonas spp*

Table 3 Biochemical Result of the Stagnant Water Cultured in MacConkey Agar Plate

Sample	Gram reaction	Catalase	Coagulase	Motility	Spore test	Citrate	Urease	indole	Methyl red	Lactose	sucrose	glucose	Identified organism
Sample 1	-R	P	N	P	-	N	N	P	P	P	N	P	*Escherichia coli*
Sample 2	-R	P	N	P	-	N	N	P	P	P	N	P	*Escherichia coli*
Sample 3	-R	P	N	P	-	N	N	P	P	P	N	P	*Escherichia coli*
Sample 4	-R	P	N	P	-	N	N	P	P	P	N	P	*Escherichia coli*
Sample 5	-R	P	N	P	-	N	N	P	P	P	N	P	*Escherichia coli*

- *Keys:*

✓ N: means negative result
✓ P: means positive result

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul321

- ✓ -: Means no reaction or absent
- ✓ -R: means negative gram reaction
- ✓ +R: means positive gram reaction

➢ *Isolation of Fungi*

Results obtained from these experiments showed that the stagnant water and scrapings contains species of fungi (yeast) which include *Candida spp*.

Table 4 Macroscopic Characteristics of the Fungi (Yeast) in Both the Scrapings and the Stagnant Water

Texture	Colour	Spore production	Presence budding/ Type of hyphae	Type of microorganism
Smooth	Creamy	Spores produced asexually	Absence of budding/no hyphae	*Candida spp*

Table 5 Microscopic Characteristics of the Fungi (Yeast) from Both Samples

Sample	Conidial head	size	Shape	surface	Conidia surface	Vesicle serration	
Scrapings	Creamy	1-2µm	Oval	Smooth walled	Smooth and regular	biserate	*Candida spp*
Stagnant water	creamy	2-4µm	Oval	Smooth walled	Smooth and regular	biserate	*Candida spp*

IV. DISCUSSION, CONCLUSION AND RECOMMENDATION

➢ *Discussion*

The main objective of this project is to identify various diseases found in water bodies in Gwarinpa District of Abuja and their impact on the health of water bodies and people. The diseases discovered after this study show that these exposed and stagnant drainage systems contain bacteria that are harmful to human health and that these systems deteriorates over time because it contains water. Drinking water regularly can be dangerous because it may contain more bacteria and viruses than tap water; it is spread through human and animal feces, especially in deserts or areas with low rainfall. Standing water for just six days can completely change the bacterial community and increase cell count. Open drains without removing domestic wastewater and rainwater, which mix with garbage, medical waste, silt, chemical waste and other pollutants and are eventually released into large bodies of water such as streams, rivers, lakes and oceans. This can lead to contamination of the water and without proper water treatment, it will make the water unfit for human consumption. Stagnant water in open water wells can also cause groundwater contamination (Ling *et al*., 2018). The dirty water on the open drains has a bad smell, which disturbs and makes people living around the open drains sick. They can also be undesirable, especially in communities where there are many children, as they may play near contaminated water, thus affecting their health (Ling *et al*., 2018).

The isolation of *Escherichia coli* (*E. coli*), in this study (used as a disease indicator) demonstrates the regular presence of fecal bacteria in water. It is also considered an infectious disease. Many strains of *E. coli* are non-pathogenic, but pathogenic bacteria can cause diseases such as diarrhea, urinary tract infections, respiratory infections, and pneumonia (Valerie *et al*., 2018).These organism strains can be beneficial or parasitic to humans and animals and sometimes cause serious illness.

Isolation of *Staphylococcus spp* is an indication of water quality reduction and a potential for pathogen survival and re-growth. *Staphylococcus aureus* can cause skin, respiratory infections, meningitis, endocarditis, bacteremia, toxic shock syndrome and other diseases. (Derek *et al*., 2017).

The identification of bacteria belonging to the genus Bacillus in this study shows that these bacteria have many physical abilities that enable them to survive in the natural environment (World Health Organization [WHO], 2014). Some species, such as *Bacillus subtilis*, occasionally cause bacteremia/sepsis, endocarditis, meningitis, and wound, ear, eye, respiratory, urinary, and gastrointestinal tract infections; other bacteria, such as *Bacillus anthracis*, can do this. They form biofilms and are resistant to many antibiotics, an important tool for their survival and disease. Biofilms of *Bacillus anthracis* cause anthrax, and the anthrax bacteria are endospores of *Bacillus anthracis*. The most common diseases are dermatoses (caused by touching unclean objects), lung disorders (caused by inhalation) and stomach diseases (similar to dermatoses but occurring in the intestinal mucosa). (Collins *et a*l., 2019). *Bacillus spp* and *Staphylococcus spp* are examples of heterotrophic bacteria that can arise from many sources of infection. These organisms use organic matter to grow and are found in all types of water, food, soil, vegetation, and air (Shakhawat, 2012).

The Pseudomonas species found in this project are pathogenic and can be found in feces, soil, water and sewage (World Health Organization, 2013). These bacteria can grow in water and also organic matter found in water. It also has the potential to be risky as it can survive on poor foods and cause different body types. It is usually caused by burns, surgery wounds, lung diseases, etc. It causes infection in patients with (WHO, 2014).

In addition, the *Candida spp* found in the study indicates the presence of disease and contamination in water bodies, and these are considered waterborne diseases. *Candida spp* are the most common pathogens associated with many human diseases and are frequently responsible for nosocomial infections in social settings (Hussain *et al*., 2011).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul321

The results of this project have shown that the exposed drainage systems in Gwarinpa Area of Abuja has many diseases that are detrimental to the environment in which it lives and most importantly to the health and sanitation of all people in that environment. This study also shows that over time, there is always water in the pipes, and the activity of bacteria in the pipes can make the water containing the bacteria bad.

- *Conclusion*

Studies have shown that the exposed drainage systems from Gwarinpa district are contaminated with bacteria such as *E. coli*, *Pseudomonas spp.*, *Candida spp* etc. The presence of all these bacteria and fungi makes it bad for living and doing other activities (social or commercial); they are also dangerous to human health, as other authors have shown that some of these diseases have similar effects as mentioned above. Therefore, water pipes must be designed so that they are not exposed to the environment.

- *Recommendation*

Based on these findings, thorough removal of water is recommended. Good hygiene is also recommended to keep the drainage system clean and dry at all times to prevent contamination. Regulatory bodies such as National Environmental Standards and Regulations Enforcement Agency (NESREA) need to investigate hygiene and sanitation in these areas, especially water pipes.

Finally, in order to achieve an environment where there are no diseases and people are healthy, the population in these regions must have a clean and hygienic environment.

REFERENCES

[1]. Atalay, M.A., Koc, A.N., Parkan, O.M., Aydemir, G., Elmali, F., Sav, H.(2017). Can serums be replaced by Mueller-Hinton agar in germ tube test?. *Nigerian Journal of Clinical Practice*. 20: 61-63.

[2]. Behera, B.C., Patra, M., Dutta, S.K., Thatoi, H.N. (2014), Isolation and characterization of sulfur oxidising bacteria from mangrove soil of mahanadi river delta and their sulfur oxidizing ability. *Journal of Applied & Environmental Microbiology*. 2(1), 1-5.

[3]. Biswas, J., Sharma K., Harris K.K., Rajput Y. (2013). Biodeterioration agents: bacterial and fungal diversity dwelling in or on the pre-historic rock-paints of Kabra-pahad, India. *Iran Journal of Microbiology*. 5(3):309–314.

[4]. Borrego, S., Lavin P., Perdomo I., Gómez de Saravia S., Guiamet P. (2012). Determination of indoor air quality in archives and biodeterioration of the documentary heritage. *International Scholarly Research Notices Microbiology*. 2012:1–10. https://doi.org/10.5402/2012/680598.

[5]. Cayford, B. I. (2012). Investigation of the Microbial Community and Processes Responsible for the Corrosion of Concrete in Sewer Systems. Ph.D. thesis, University of Queensland, St Lucia, QueensLand.

[6]. Collins, J. C., Ian, T. K., Noam, R., Kathleen, A. A., Martin, E. H., Mark, F., Brett, T. E., Tasha, E., Todd, K. S., Wenyi, Z., Mehriban, B., Wayne, M. G., Jason, K. B. (2019). The global distribution of Bacillus anthracis and associated anthrax risk to humans, livestock and wildlife. *Nature microbiology*. 4 (8): 1337-1343.

[7]. Dakal, T.C., Cameotra, S.S. (2012).Microbially induced deterioration of architectural heritages: routes and mechanisms involved. *Environmental Science Europe*. 24(1):1–13. https://doi.org/10.1186/2190-4715-24-36.

[8]. Derek, E. M., Kenneth, W. B. (2017). *Staphylococcus aureus* biofilm: a complex developmental organism. *Molecular microbiology*. 104 (3): 365-376.

[9]. Dopson, M., and Johnson, D. B. (2012). Biodiversity, metabolism and applications of acidophilic sulfur-metabolizing microorganisms. *Environmental Microbiology*. 14:2620–2631. https://doi.org/10.1111/j.1462-2920.2012.02749.x.

[10]. Feng, S., Yang, H., and Wang, W. (2015). System-level understanding of the potential acid-tolerance components of Acidithiobacillusthiooxidans ZJJN-3 under extreme acid stress. *Extremophiles*.19: 1029–1039. https://doi.org/10.1007/s00792-015-0780-z.

[11]. George, R.P., Vinita, V., samal, S.S., and Kamachi, M.U. (2012). Current understanding and future approaches for controlling microbially influenced concrete corrosion: A Review published by Issres. *Concrete Research*.3: 491-506.

[12]. Ghazy, E.A., Mahmoud, M.G., Asker, M.S., Mahmoud, M.N., Abo-Elsoud, M.M., and Abdel Sami, M. E. (2011). Cultivation and Detection of Sulphate Reducing Bacteria (SRB) in Sea Water. *Journal of American Science*. 7(2), 604-608.

[13]. Giebson, C., Voland, K., Ludwig, H.M., Meng, B. (2017). *Structural Concrete*. 18:528-538

[14]. Glinicki, M.A., Jaskulski, R., Dąbrowski, M. (2016). *Roads and Bridges*. 15(1): 21-43

[15]. Gomez-Alvarez, V., Revetta, R. P., and Santo Domingo, J. W. (2012). Metagenome analyses of corroded concrete wastewater pipe biofilms reveal a complex microbial system. *Biological Medical Central Microbiology*. 12:122. https://doi.org/10.1186/1471-2180-12-122.

[16]. González, D. M., Lara, R. H., Alvarado, K. N., Valdez-Pérez, D., Navarro-Contreras, H. R., Cruz, R., et al. (2012). Evolution of biofilms during the colonization process of pyrite by *Acidithiobacillus thiooxidans*. *Applied Microbiology Biotechnology*. 93:763–775. https://doi.org/10.1007/s00253-011-3465-2.

[17]. Heisig, A., Urbonas, L., Beddoe, R.E., Heinz, D. (2016). *Material Structure*. 49: 4291–4303.

[18]. Huber, B., Drewes, J., Lin, K., König, R., Müller, E. (2014).Revealing biogenic sulfuric acid corrosion in sludge digesters: detection of sulfur-oxidizing bacteria within full-scale digesters. *Water Science Technology*. 70(8):1405–11.

[19]. Hussain, T., Hussain, A., Sultana, K. (2011). Study of drinking water fungi and its pathogenic effects on human beings from district Bhimber Azad

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul321

Kashmir, Pakistan. *Pakistan Journal of Botany*. 43(5): 2581-2585.

[20]. Hvitved-Jacobsen, T., Vollertsen, J., and Nielsen, A. H. (2013). Sewer Processes: Microbial and Chemical Process Engineering of Sewer Networks. Boca Raton, Florida: Chemical Rubber Company press. https://doi.org/ 10.1201/b14666.

[21]. Jiang, G., Keating, A., Corrie, S., O'halloran, K., Nguyen, L., and Yuan, Z. (2013). Dosing free nitrous acid for sulfide control in sewers: results of field trials in Australia. *Water Resource*. 47: 4331–4339. https:// doi.org/10.1016/j.watres.2013.05.024.

[22]. Joseph, A.P., Keller, P., Bustamante, H., Bond, P.L. (2012). Surface neutralization and H_2S oxidation at early stages of sewer corrosion: Influe nce of temperature, relative humidity and H_2S concentration. *Water Resource*.46: 4235-4245. https://doi.org/10.1016/j.watres.2012.05.011.

[23]. Ling, A. L. (2013). Characterization and Control of Microbially Induced Concrete Corrosion. Ph.D. thesis, University of Colorado at Boulder, Boulder, Colardo.

[24]. Ling, A. L., Robertson, C. E., Harris, J. K. , Frank, D. N., Kotter, C. V., Stevens, M. J., Pace, N. R., Hernandez, M. T. (2015) Microbial Community Succession of Microbially Induced Concrete Corrosion in Working Sanitary Manholes. *Public Library of Science One*. 10: 1-12. https://doi.org/10.1371/journal.pone.0116400.

[25]. Ling, F., Whitaker, R., LeChevallier, M.W., Liu, W. (2018)."Drinking water microbiome assembly induced by water stagnation". *Journal of Microbial Ecolgy*.12 (6):1520-1531. doi:10/1038/s41396-018-0101-5.1SSN 1751-7362.PMC 5955952.PMID 29588495.

[26]. Nath, K., Solanky, K.U., Bala, M. (2015) Management of Banana (Musa Paradisiaca 1 L) Fruit Rot Diseases using Fungicides. *Journal of Plant Pathology and Microbiology*. 6: 298. doi:10.4172/2157-7471.1000298.

[27]. Rajabipour, F., Giannini, E., Dunant, C., Ideker, J.H., Thomas, M.D.A. (2015).*CementConcrete Resource*. 76: 130–146.

[28]. Shakhawat, C. (2012). A review on "Heterotrophic bacteria in drinking water distribution system". *Environmental monitoring and assessment*. 184 (10), 6087-6137.

[29]. Sudipta, M., Manas, S., Trinath, C., Brajadulal, C., Saroj, M. (2012).Use of bacterial protein powder in commercial fly ash pozzolana cements for high performance construction materials, *Open Journal of Civil Engineering*. 2: 218-228.

[30]. Valerie, S. F., Chelsie, E. A., Sara, N. S., Ali, P., Cody, A. S., Matthew, S. W., Greta, R. N., Stephanie, D. H., Evan, S. S., Harry, L.T. M. (2018). Rapid growth of uropathogenic Escherichia coli during human urinary tract infection. *Microbiology and molecular Biology*. 9 (2).

[31]. Wei, S., Jiang, Z., Liu, H., Zhou, D., Sanchez-Silva, M. (2013).Microbiologically induced deterioration of concrete: a review. *Braz Journal of Microbiology*. 44(4):1001-1007.

[32]. World Health Organization (WHO) & United Nations Children's Fund [UNICEF]. (2013). Progress toward global immunization goals. Summary representation of key indicators. http://www.who.int/immunization/monitoring_surveillance/SlidesGlobalImmunization.

[33]. World Health Organization (WHO) & United Nations Children's Fund (UNICEF). (2014). Progress on Sanitation and Drinking – water. Geneva: WHO Press.

[34]. Yousefi, A., Allahverdi, A., Hejaz, P. (2014). Accelerated biodegradation of cured cement paste by Thiobacillus species under simulation condition. *International Biodeterioration Biodegradation*.86: 317-326. https://doi.org/10.1016/j.ibiod.2013.10.008

[35]. Yuan, H., Dangla, P., Chatellier, P., Chaussadent, T. (2015). Degradation modeling of concrete submitted to biogenic acid attack. *Cement Concrete Resource*. 7 https://doi.org/10.1016/j.cemconres.2015.01.002.