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Abbreviations list

ASR	Anaerobes Sulfito Reducers
BCPL	Bromo Cresol Purple Lactose
CT	Total coliforms.
CF	Fecal coliforms
CT	Total coliforms
D/C	Double concentration
EMB	Eosin methylene blue
Eva Litsky	Ethyl violet azide
L.B.	Luria Bertani
McC	Mac Conkey.
M.R.S.	Man, Rogosa, Sharpe
MSA	Mannitol Salt Agar
MPN	Most probable number
CFU	colony Forming units.
TGEA	Tryptone Glucose Extract Agar

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Introduction

Water represents a vital resource for all living beings, whether animals, humans or plants, and plays an essential role in global environmental balance. However, in case of contamination the water can also become a deadly threat. With approximately 72% of the Earth's surface covered in water, this phenomenon has inspired the description of our planet as the "blue planet" (Colas, 1964).

Fresh water has become an increasingly rare and valuable resource, accounting for only about 2.8% of all water in the universe. Of this amount, only 2.1% is found as polar ice, while 0.7% is available as liquid fresh water. The latter is crucial for the survival of all living organisms, especially human beings, provided that it is free from chemical contaminants (such as toxic substances and excess mineral and organic matter), or biological contaminants (such as pathogenic germs). The continued availability of this fresh water is therefore an essential event, of capital and constant importance. It comes from various sources such as groundwater, glaciers and springs (Kandalaft, 2017).

Dams, by retaining this fresh water, play a crucial role in providing a multitude of socio-economic benefits, such as regulating rivers, generating hydroelectric power, and providing water for various uses. These key infrastructures also support biodiversity by creating aquatic habitats, where dam fish play an essential role. These fish, adapted to environments modified by humans, contribute to the regulation of populations and the maintenance of the stability of aquatic habitats, while presenting unique ecological and behavioral characteristics (Postel and Richter, 2003).

Assessing the microbiological quality of reservoir waters and fish is essential to protect public health and aquatic ecosystems. Dams often alter the microbiological characteristics of water, which can impact the health of fish and the humans who consume them. This assessment involves monitoring the levels of various microorganisms, originating from sources such as sewage, agricultural waste and human activities (Arthington et Zalucki, 2013).

As part of our dissertation, we were interested in studying the evaluation of the microbiological quality of water and TILESDIT dam fish. Our dissertation is divided into four parts: the first is a bibliographical synthesis intended for the generalities of water, as well as the different pollutants existing in water as well as their origin the different bacteriological and physico-chemical parameters (Bacteria, indicator of fecal contamination, and diseases caused by these bacteria); the second describes a generality of fish; Concerning the third part, it

presents the study area as well as the equipment and experimental protocols adopted for the microbiological characterization of water and fish in the study area, and finally the last part describes our results obtained then discussion followed by conclusion and perspectives.

Chapter I

General information on water

I.1. General information on water

Water is omnipresent on earth, and its presence is essential for the survival of human life. Plants, animals and land activities depend on this vital resource. The water is opens 70 to 80% of the Earth's total surface. Almost 98% of this amount consists of salt water, not suitable for human consumption. Less than 1% of available water is drinkable, and most of this vital resource is trapped in snow and polar ice (Lassoued,2008).

I.2. Definition of water

Water is a chemical substance essential to life as we know it. Its chemical formula is H_2O, which means that a water molecule is composed of two hydrogen atoms bonded to one oxygen atom. Water is a transparent, colorless, odorless and tasteless liquid in its pure state. It is present in a liquid state at common temperatures, but can also occur as ice at lower temperatures and vapor at higher temperatures (Mounchar, 2021).

Water is found naturally in oceans, rivers, lakes, glaciers, groundwater and the atmosphere. It circulates through the water cycle, passing through phases of condensation, precipitation, evaporation and runoff, thus contributing to maintaining the planet's water balance (Mouchar, 2021).

I.3. Types of pollution

I.3.1. Physical pollution

Of natural origin occurs when small mineral elements such as fine sand, silts and clays, become suspended during heavy rain or floods , (can be caused by radioactivity, heat or the transport of suspended materials or particles) (Chartier, 1974).

I.3.2. Chemical pollution

Come from a variety of sources, including mineral and organic industrial wastes. They are divided into two categories: degradable, the nature or quantity of which can be altered by biological, chemical or physical processes, and non-degradable, which do not undergo modification in aquatic environments by biological processes. Among these pollutants, we find agricultural fertilizers, pesticides, organochlorine compounds, hydrocarbons and detergents. Lead, arsenic and mercury are toxic elements that accumulate in living organisms and can cause serious damage to human organs when absorbed through the food chain or by plankton (Chartier, 1974).

I.3.3. Biological pollution

It is characterized by the presence of pathogenic microorganisms in water, thus posing a risk to human health and aquatic life. This contamination is generally due to direct discharges of untreated contaminated effluents containing organic waste such as domestic and hospital wastewater, animal excrement such as slurry, as well as certain waste from the agro-food industries. Most of these pathogenic microorganisms in water are viruses, bacteria, protozoa and fungi, responsible for serious diseases such as cholera, typhoid and dysentery. In the past, these pathogens have triggered catastrophic epidemics across the world (Haslay, 1993).

I.3.4. Agricultural pollution

Arises from the unregulated use of fertilizers, pesticides, herbicides and fungicides. Modern agricultural practices sometimes involve intensive plowing, thus favoring direct infiltration of pollutants such as nitrates, nitrites, sulfates, phosphates and chlorine into groundwater (Chartier, 1974**).**

I.4. Physico-chemical parameter

I.4.1. Temperature

Temperature is a physical quantity, used as a very important parameter in water analysis. It is usually measured in degrees Celsius (°C) in the metric system with a thermometer (Hoffmann et *al*., 1995). Plays a role in the dissociation of dissolved salts in relation to electrical conductivity (because when the temperature increases the conductivity it also increases, therefore the increase in water temperature promotes the dissolution of mineral salts and the mobility of ions this which increases conductivity in water), it is also used to measure pH (Poirel, 2010).

I.4.2. Turbidity

The turbidity of the water, due to the presence of suspended particles, makes it possible to evaluate the concentration of colloidal particles present, which makes the water cloudy or opaque. Then is measured by nephelometric turbidity units (NTU). Raw water turbidity can vary, sometimes being as low as 1 or 2 NTU in groundwater, while it can reach several hundred in surface waters with more pronounced turbidity (Rodier, 2009).

I.4.3. pH

According to Rodier (1996)**,** The term "pH", meaning Potential of Hydrogen in water, is measured using a pH meter or colorimetry. Then a low pH indicates that the water is acidic, a high pH indicates that the pH is basic.

I.4.4. Electrical conductivity

Conductivity measures the ability of water to conduct an electric current. Since the electric current is conducted by the movement of ions in solution, the conductivity increases when the concentration of the ions increases. It also makes it possible to assess the quantity of salts dissolved in the water; is measured by conductivity meter (TDS tester) and soundunit: µS/cm at a temperature of 25°C (Rodier, 2009).

I.5. Bacteriological parameter

Microbiological water quality monitoring relies largely on the examination of indicator bacteria such as coliforms, *Escherichia coli*, fecal *Streptococcus*. *E. coli* is part of the fecal coliform group and is a more specific fecal pollution indicator than other fecal coliforms (Stephen et *al.*, 2013).

I.5.1. *Enterococcus* (fecal *Streptococcus*)

According to Flahaut (1997)**,** *enterococcus* are spherical bacteria; Gram positive; catalase negative and facultative anaerobic, are commonly sought in water analyzes to detect the presence of enteropathogenic organisms. They are used as an indicator of fecal contamination (of human and animal origin). *Enterococcus* do not multiply in water, but coliforms do; they are less numerous than coliforms in human feces.

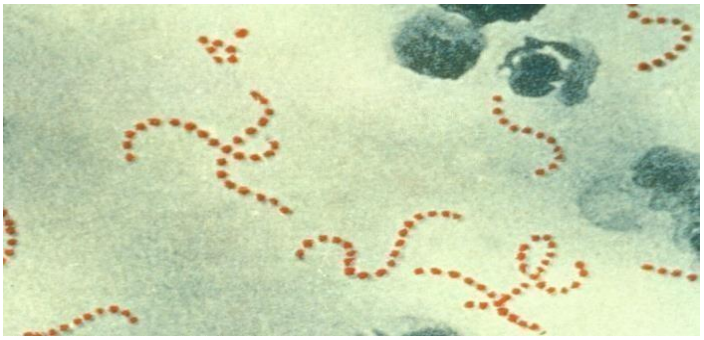

Figure 1: Fecal *Streptococcus* (Anonymous 1)**.**

I.5.2. Total coliforms

The presence of total coliforms is an indicator of bacterial pollution, particularly fecal contamination. It is a gram-negative, non-spore forming rod-shaped bacteria, aerobic or facultative anaerobic, it is capable of multiplying in the presence of bile salts and fermenting lactose with gas production at 37°C.

The predominance of coliform bacteria includes the following genera: *Escherichia, Citrobacter, Rhanella, Klebsiella, Kluyvera* and *Enterobacter* (Archibald, 2000).

I.5.3. Fecal coliforms

These are bacteria which detect the presence of fecal contamination at a temperature of 44°C. Are capable of fermenting lactose with production of acid and gas at 36 and 44°C. Are Gram-negative, aero bic and facultatively anaerobic bacteria; sticks; non-sporulating (Ouhmidou, 2015).

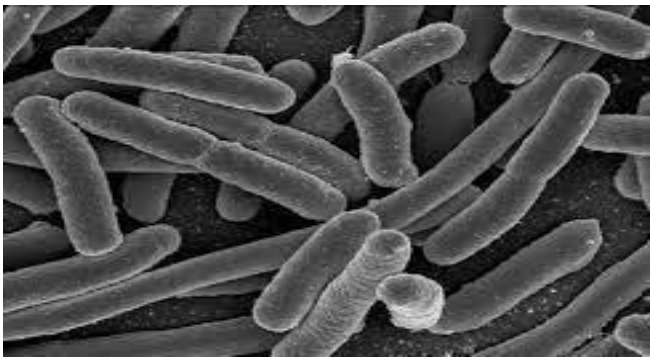

Figure 2: Fecal coliforms (Anonymous 2).

I.5.4. *Escherichia coli*

Is an indicator of fecal contamination, survives in surface water for 1 to 10 weeks at temperature 14 to 20C°, as they can survive in groundwater for 1 to 14 weeks. Since they cause gastrointestinal diseases, it is commonly present in the intestines of humans and animals, particularly in human feces (Leclerc et *al.*, 2001).

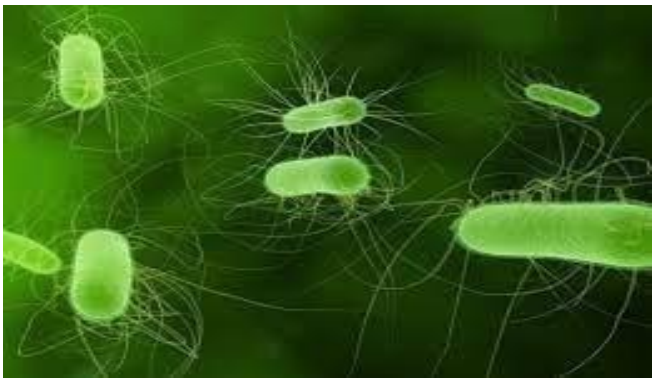

Figure 3:*Escherichia coli* (Anonymous 3).

I.5.5. Sulphite-reducing clostridium

The genus *Clostridium* is one of the largest bacterial genera,they are spore-forming bacteria, gram-positive, and strictly anaerobic (Durre, 2014).

Sulphite-reducing Clostridium are often associated with signs of old fecal pollution (Lebbihi, 2018).

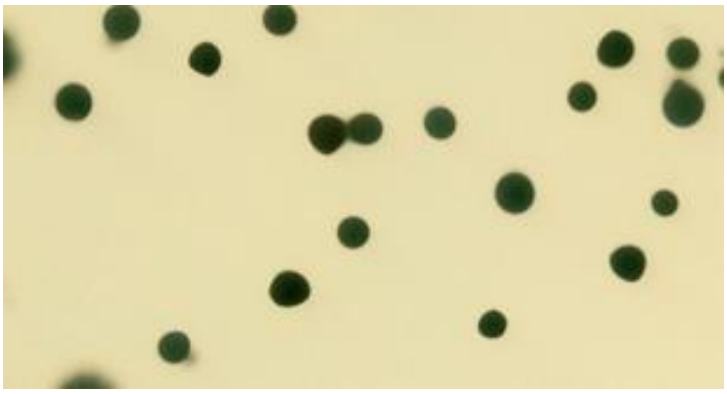

Figure 4: *Clostridium* (Anonymous 4).

I.6. Waterborne diseases

Water contamination caused by pathogens is a pollution problem. Waterborne diseases are all caused by the ingestion of water contaminated by fecal matter of animal or human origin, containing pathogenic microorganisms (Saab, 2007), Among these diseases:

I.6.1. Cholera

Cholera disease does not die out. It appeared in Peru in 1991, sickening 300,000 people and causing 1,500 deaths (Majour, 1997).

Cholera is an infectious, transmissible diarrheal disease of epidemic nature, of Bacterial origin (due to a bacteria called *Vibrio cholerae* of a gram negative) (Pierre Aubry et *al.*, 2023).

Cholera is transmitted to humans through contaminated food and water and is considered a disease of poverty, hunger and overpopulation (Berche, 1999).

In (2018): the return of cholera disease is observed in the wilayas of Bouira, Blida, Tipaza. 217 cases of illness caused the death of two cases.

I.6.2. Typhoid fevers

According to Monjour (1997) By 1950, typhoid fever was a distant memory, but systemic infections caused by *Salmonella typhus* were still widespread in some countries, communities and neighborhoods. It causes illnesses such as fever, headaches, anorexia, slow heart rate, etc.

According to Vieu (1972)**,** he finds the disease typhoid fever in certain third world countries, it is an endemic infection linked to the precariousness of sanitary conditions.

Typhoid fever (TF) is responsible for 20 million cases annually with 200,000 deaths worldwide (Crump, 2004).

I.6.3. Paratyphoid fever

A bacterial disease caused by *Salmonella enterica Paratyphi*. General symptoms: high fever, malaise and sometimes diarrhea. The infection can be carried and transmitted without having symptoms. The infection is usually treated with antibiotics (Gilles et *al*., 2009).

I.6.4. Poliomyelitis

Is an infectious disease caused by the poliovirus. Man is the reservoir of viruses, the transmission of polioviruses occurs by the fecal-oral or oral-oral route (Barois, 1980).

I.6.5. Dysentery

Oushigellosis: isan infectious disease caused by an enterobacterium: Shigella Dysentery is characterized by watery diarrhea accompanied by blood, mucus withpain (Xavier et *al.*, 2007).

I.6.6. Viral hepatitis

Hepatitis A acute infectious disease of the liver caused by a hepatitis A virus of the picornavirus family. Ase hepatitis is transmitted by the fecal-oral route: through food or water. Also called (Salty Hand Disease) (Kpossou, 2020).

I.6.7. Schistosomiasis

Is a major parasitic waterborne disease constituted after malaria due to Trematodes of the schistosoma genus. Schistosomiasis in humans is caused by 03 main parasites (haematobuim, mansoni, jaboni), 200 million people in the world have been infected by schistosome.

According to WHO. In 1914: schistosomiasis was discovered in Marrakech (Abdellahi et *al.*, 2016)

Tableau 1: The main waterborne diseases and their causative agents (Kherifi, 2016).

Origin of diseases	The different diseases	Pathogens
Diseases of bacterial origin	Cholera	*Vibrio cholerae*
	Typhoid fevers and paratyphoid	*Typhoid Salmonella Paratyphoid Salmonella A, B*
	Acute gastroenteritis and diarrhea	*Escherichia coli*
	Bacillary dysentery	*Shigella sp*
Viral diseases	Hepatitis A, EPolio	Hepatitis A virus, E Polio virus
Parasitic diseases	Amoebic dysentery parasite gastroenteritis	Entamoeba histolytica

I.7. Illnesses attributed to chemical water

I.7.1. Nitrate NO^{-3}

Nitrates can be harmful to children, especially infants, which are very sensitive to excessive absorption, a blood poisoning known as methemoglobinemia, or blue sickness. Nitrates do not present a health hazard in themselves. However, when they are metabolized by bacteria in the human body, they turn into nitrites. These nitrites then oxidize the hemoglobin in the blood, preventing its ability to bind oxygen and thus disrupting cellular respiration (Festy et *al.*,2003).

Even at low concentrations, nitrates have a long-term risk of cancer in adultswhen combined with certain pesticides, forming potentially carcinogenic compounds (Festy et *al.*,2003).

Symptoms of this disease include cyanosis, which manifests as a bluish discoloration of the skin and lips, as well as difficulty breathing and pronounced fatigue (Idrissi, 2006).

Chapter II

General information about fish

II.1. General information about fish

Fish are all aquatic vertebrates that are not tetrapods. These lower vertebrates live in water, have fins and generally have their bodies covered with scales. There are approximately 24,500 different species recognized based on their multiple morphological, anatomical and physiological characteristics which can differentiate new species (Abdellah Morsi, 2015).

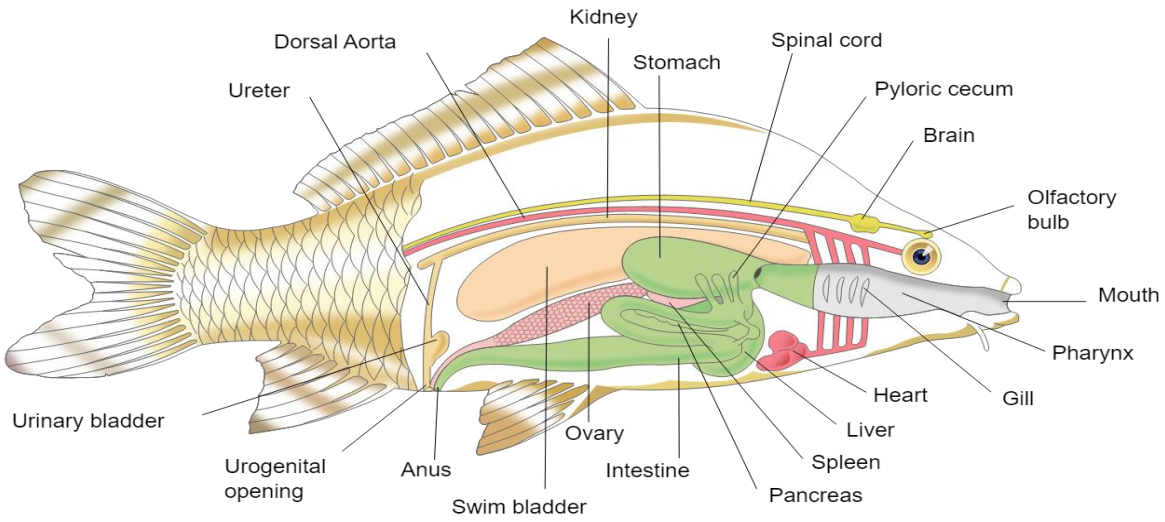

Figure 5:the general morphology of a fish (Anonymous 5).

The world is estimated to have approximately 10,000 species of exclusively freshwater fish, as well as 227 species of diadromous fish that spend part of their lives in freshwater (Bacha, 2007).

Fish is known to be a premium nutritional source due to its exceptional concentration of essential nutrients such as proteins, lipids, fat-soluble vitamins and minerals. In addition, its richness in polyunsaturated fatty acids, beneficial for human health, makes it a particularly valuable food (Laid et Bendjdou, 2023).

The study and classification of fish involves the identification of different taxonomic groups, based on criteria such as morphology (shape, fins, etc.), anatomy, osteology, and more recently, genetics. Fish, in their broadest sense, encompassing all aquatic vertebrates except tetrapods, have always been the focus of research in ecology, biology and other scientific fields. It is crucial to emphasize that fish, in general, and those living in fresh waters in particular, are considered by evolutionary biologists as essential elements of ecosystems, playing a vital role

in food chains and in the preservation of biodiversity (kraiem, 1980).

Fish is recognized for its high nutritional value for humans, and for many years it has been used in the production of concentrated feeds. Many fish species are high in fat, making them an important source of oil. Additionally, they are also rich in protein, making up about 25% of the animal's total weight (Kadri, 2008).

Fish are very diverse and can be classified into several types based on different criteria.

II.2. Types of fish pollution

II.2.1 Chemical pollution

Pollution caused by human activities which reach rivers, and especially fresh water such as: fertilizers, pesticides, herbicides, detergents, chemicals, these materials are deposited on the banks of rivers and seas, causing the death of marine organisms (Ramade,2007). And freshwater fish are the most problematic because they are consumed by humans.

II.2.2 Mechanical pollution

According to Cuinat (2008)**,** mechanical pollution Characterized by the accumulation of suspended matter.

Certain mineral particles from industries and released into waterways cause turbidity in the water and thus affect aquatic organisms such as freshwater fish (drilling, dam emptying, geothermal energy).

II.2.3 Plastic pollution

Plastic waste Present everywhere, causing contamination of foods such as: fish, fresh water, algae, etc., we find them in food.

This type of pollution, also called microplastic, causes the direct death of certain animals such as marine animals such as freshwater fish (Eriksen et *al*., 2020).

II.2.4 Pollutionbright

Pollution of human origin affects the life and activity of animals and alters their physiologies (Rosolen et *al*., 2019).

Artificial light, caused by man, is known because it is a group of lights that have a negative and dangerous impact (disrupt biological rhythms) on the life of animals and plants, especially fish migration. in fresh water (Falchi et *al*., 2016).

II.3. Fish pathogenic bacteria

Pathogenic bacteria present in fish are microorganisms capable of triggering diseases in farmed or wild fish. They are found naturally in aquatic environments or introduced into fish populations through various means, such as contaminated water, infected fish, contaminated equipment or unsanitary breeding practices. Common pathogenic bacteria in fish are:

II.3.1 *Flavobacteriaceae*

Flavobacteriaceae, although having a wall typical of gram-negative bacteria, are placed in the Bacteroidetes (formerly "FCB group" for Flavobacterium Cytophaga-Bacteroides) (Bernardet et Nakagawa, 2006).

The bacterial genus Flavobacterium includes species found in various environments such as fresh water, oceans. Some can cause disease in fish. One such species is *F. columnare*, which is responsible for external infections in many freshwater fish species. This bacterium can cause columnariasis, a bacterial disease in freshwater fish that affects the skin and gills, leading to necrotic plaques, erosions and ulcerations. The disease can progress rapidly, leading to lethargy, anorexia and high mortality rates in affected fish populations (Davis, 1922).

Conversely, *F. psychrophilum* is a cold fresh water bacterium that often causes hemorrhagic septicemia in salmonids (Bernardet, 2006).

II.3.2 *Flavobacterium columnare*

Causing columnarit is accompanied by necrotic lesions of the skin, fins and gills containing yellow-pigmented bacteria, often followed by mortality, this bacterium affects several species of freshwater fish, including carp, sturgeon and catfish (Shoemaker et *al*., 2007).

II.3.3 *Chlamydiae*

This new *Chlamydiae* was found in freshwater salmonids, and based on its partial 16S rRNA gene, it may constitute a third genus in the family *Chlamydiaceae*, or a closely related sister family (Karlsen et *al*.,2008).

Chlamydia infections of fish are emerging as an important cause of disease in new and established aquaculture industries. To date, epitheliocystis, a skin and gill disease associated with infection by these obligate intracellular pathogens, has been described in more than 90 fish species, including hosts from marine environments and pure water (Stride et *al*., 2004).

II.3.4 *Francisella*

Is a bacterium of the *Francisellaceae* family as a cause of diseases in farmed and wild species of fish and crustaceans such as Atlantic cod, Gadus morhua L., tilapia, Oreochromis spp., Atlantic salmon. Most of the information available to date concerns disease in cod, caused by *F. noatunensis*, and in tilapia, caused by *F. noatunensis* subsp. Both causing granulomatous inflammatory reactions. Mortalities in both species can be high, and as the disease can likely be transmitted via live fish movements, they pose a significant threat to tilapia and cod aquaculture operations (Birkbeck et *al*., 2011).

Then an aquatic bacterium causes an emerging disease which can cause mortality in the hybrid striped bass Morone chrysops M. saxatilis reared intensively in fresh water (Ostland et *al.*, 2006).

II.3.5 *Aeromonas salmonicida*

*Aeromonas salmonicida*is a Gram-negative bacterial pathogen that causes disease in fresh, brackish and marine fish, whether wild or farmed. Due to its widespread presence worldwide and its economic impact on aquaculture and salmonid conservation, this bacterium has been studied for over a century. The subspecies *A. salmonicida salmonicida*, also called "*typical A. salmonicida*", is linked to an acute to chronic disease called "furunculosis" in salmonids. Other subspecies of *A. salmonicida*, called "atypical *A. salmonicida*", can cause ulcerative and systemic diseases in many types of fish, including salmonids (Boily et *al*., 2019).

This bacterium is responsible for the disease called furunculosis, which mainly affects salmonids such as trout and salmon (Austin, 2012).

II.3.6 *Edwardsiella ictaluri*

Edwardsiella ictaluri, a non-zoonotic Gram-negative bacterium.Diseases caused by E. ictaluri are known as enteric catfish septicemia (ESC) in channel catfish, bacillary pangasius necrosis (BNP) in striped catfish, red head disease in yellow catfish and edwardsiellosis in tilapia. Outbreaks caused by E. ictaluri can lead to mortality (Machimbirike, 2022).

II.3.7 *Vibrio spp.*

Several species of *Vibrio* can infect fish, causing various diseases, including vibriosis, which often affects marine fish (Austin, 2007).

II.3.8 *Streptococcus iniae*

This bacterium can cause serious infections in various species of fish, including freshwater and saltwater fish (Shoemaker et *al*.,2000).

*Streptococcus iniae*is a pathogen in fish, capable of causing invasive diseases and outbreaks in aquaculture farms (Weinstein, 1997)

II.3.9 *Piscirickettsia salmonis*

This bacterium is responsible for salmonicultura or yellow drop disease syndrome, a serious disease in salmonids (Rozas et Peña, 2020).

II.3.10 *Renibacterium salmoninarum*

Renibacterium salmoninarum, the causative agent of bacterial kidney disease (BKD), a chronic bacterial disease affecting both wild and farmed salmonids. And the gram-positive fish pathogen (Kroniger,2022).

Chapter III

Material and methods

III.1. Presentation of the study area

The TILESDIT dam is located in the north-central region of Algiers. It is located 18 km east of the town of Bouira in the Bechloul region and 4 km from national road No. 5 Algiers – Constantine. It is made up of a basin attached to three communes of the wilaya of Bouira: commune of El Asnam, commune of Bechloul, commune of Haizer. This dam was started work in 1996 and put into service in 2004 is an embankment type dam with a height of 65m, and a capacity is 186 million m3. The TILESDIT dam is intended to supply the industrial region of Sidi Khaled, El-Hachmia. It also ensures the supply of drinking water to the entire population of the wilaya of Bouira, in particular the communes of the southeast such as Tagdit, Ouled-Rached, and Mesdours as well as the irrigation of the EL Asnam plateaus. and the Sahel Valley.

Figure 6: The TILESDIT dam situation (Google Maps image).

Figure 7: View of TILESDIT dam (Original).

III.2. Sampling equipment

Bacteriological samples must be collected in bottles subject to rigorous cleaning and good sterilization. It is recommended to use glass bottles.

Then, we have put a few drops of sodium thiosulfate to make the chlorine function inactive in the waters having undergone chlorine disinfection after we moved on to sterilization. It is done in an autoclave for 30min at 120°C/2bar pressure (ISO 19458, 2006).

Step 1: We have put the bottles in a container containing tap water + a few drops of bleach + detergent for 24 hours;

Step 2: The bottles were dried in the open air;

Step 3: 5 drops of sodium thiosulfate were added;

Step 4: Afterwards we have went to the autoclave sterilization cycle for 30 minutes at 120°C/bar pressure.

III.3. Sampling methods

The water was taken from a depth of 20 meters. All samples were taken between 8 a.m. and 10 a.m. After collection, the samples are carefully labeled and then transported to the laboratory. (Rodier,2009).

III.4. Bacteriological analyzes

III.4.1. Research and enumeration of aerobic germs that can be revived at 22°C and 37°C

- **Principle**

It consists of an estimate of the total number of germs present in the water (ISO 6222).

- **Method**

The steps in the analysis of total germs are summarized as follows (fig.8):

- ✓ For 1ml of the sample into two Petri dishes;
- ✓ Complete with 20ml of TGEA agar (Tryptone Glucose Extract Agar) cooled to 50°C (Appendix III), Petri plate ;
- ✓ Then, shake gently in a circular motion to ensure homogeneous mixing of the water with the agar without creating air bubbles. Let cool.
- ✓ At the end, incubate the inverted plates (to avoid dehydration of the agar) at 37°C for 48 hours and at 22°C for 72 hours (ISO 6222; NA763**).**

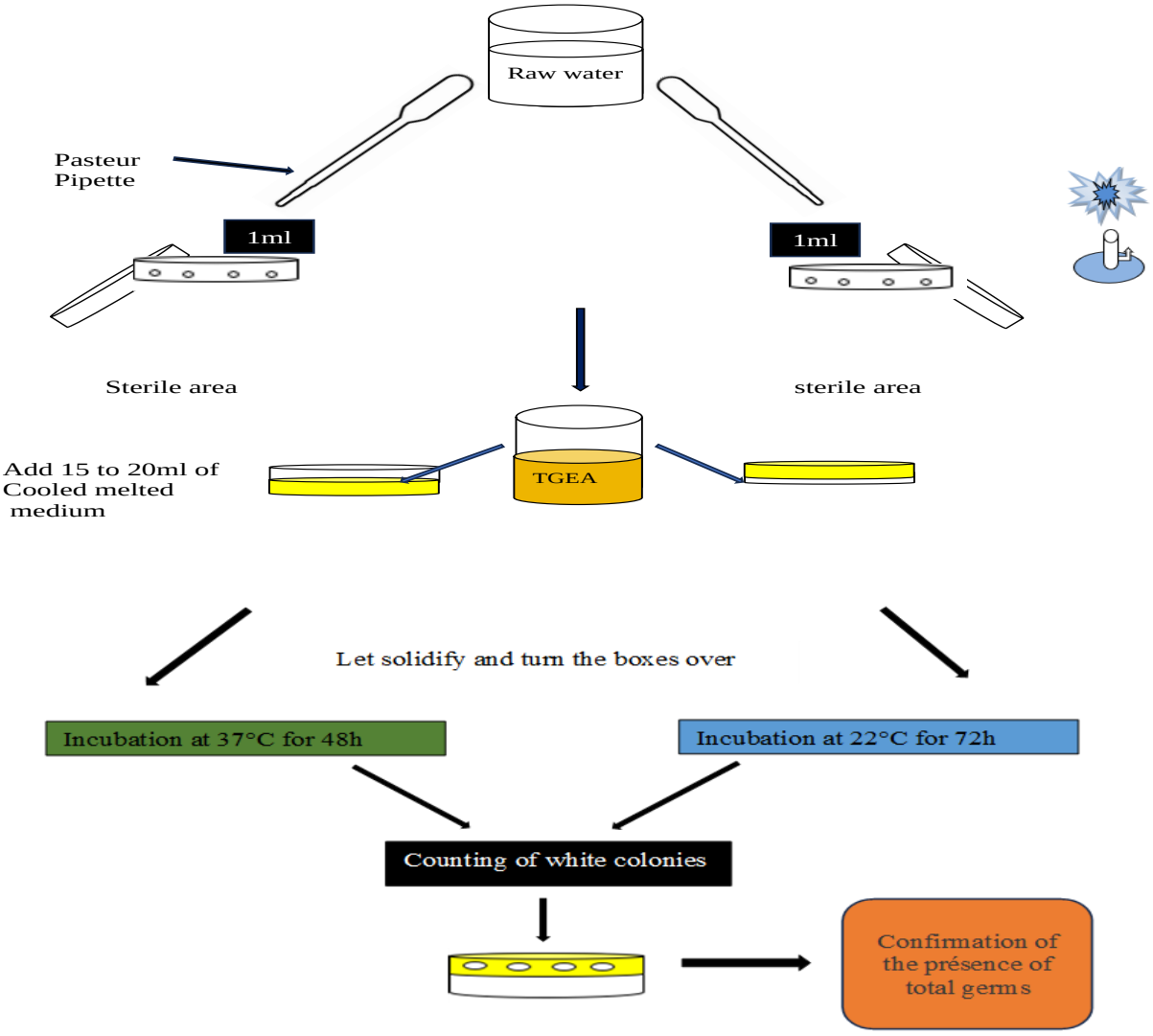

Figure 8: Explanatory diagram for the research and enumeration of total germs**.**

III.4.2. Research and enumeration of fecal contamination germs

III.4.2.1. Detection and enumeration of total, thermotolerant coliforms and confirmation of *Escherichia coli* in liquid media (MPN)

- **Principle**

Consists of counting coliform germs and among them *Escherichia coli.*

It has two stages:

- Presumptive research.
- Confirmatory research.

After inoculating the sample, the tubes containing a culture medium that is not truly

selective but makes it possible to demonstrate the fermentation of lactose with gas production, transplant the positive tubes onto a liquid medium (confirmation medium) containing tryptophan (Schubert) incubated at 44°C to enumerate coliforms and detect presumptive *Escherichia coli.*

Determination of the characteristic number (number of positive tubes) of coliforms by consulting the table MPN (Appendix IV) (Norme NF T90-413).

➢ **Material**

- Mac Grady MPN table (most probable number) (Appendix II).

Culture media and reagents

❖ 1 bottle of BCPL (lactose broth with bromocresol purple) double concentration of 50ml. (Appendix III)
❖ 3 tubes of double concentration BCPL of 10ml fitted with a bell.
❖ 3 tubes of BCPL single concentration of 10ml fitted with a bell.
❖ Schubert medium fitted with a bell (for CF).
❖ Kovacs reagent (For *E. coli*).

A. Coliform testing (presumptive testing)

Enumeration was performed using BCPL broth. All tubes are fitted with Durham bells to detect the release of gas in the environment.

For this bacteriological analysis (fig.11), we used the 3/3/3 system (less loaded), that is to say: We seeded:

✓ 3 tubes of 10ml of BCPL broth a D/C with 10ml of water.
✓ 3 tubes of 10ml of BCPL broth a S/C with 1ml of water.
✓ 3 tubes of 10ml of BCPL a S/C broth with 0.1ml of water.
✓ The bell must not contain gas initially.
✓ The tubes were incubated at 37°C for 48 h.

Reading

➢ after 48 hours of incubation. All tubes showing a reading with a change from broth to yellow and gas in the bell are considered positive, i.e. containing coliforms.
➢ the number of positive tubes in each series and we refer to the MPN table to obtain the number of coliforms present in 100ml of water.

- This phase is based on the property common to coliforms to ferment lactose by producing gas (NF T90-413 standard).

B. Testing for fecal coliforms (confirmatory research)

Has from each positive BCPL tube for coliform testing:

- ✓ 2 to 3 drops were inoculated into a tube containing Schubert medium fitted with a Durham bell.
- ✓ Then were incubated at 44°C for 24 hours (fig.11).
- ✓ After incubation, all tubes showing a turbid mediums and gas in the bell are considered positive, i.e. containing fecal coliforms.

Note: fecal coliforms are part of total coliforms. It is virtually impossible to find more fecal coliforms than total coliforms (Norme NF T90-413).

C. **Testing for *Escherichia Coli***

A few drops of Kovacs reagent were added to the positive Schubert tubes. (fig.11). A red ring on the surface, witness to the production of indole by *Escherichia Coli.*

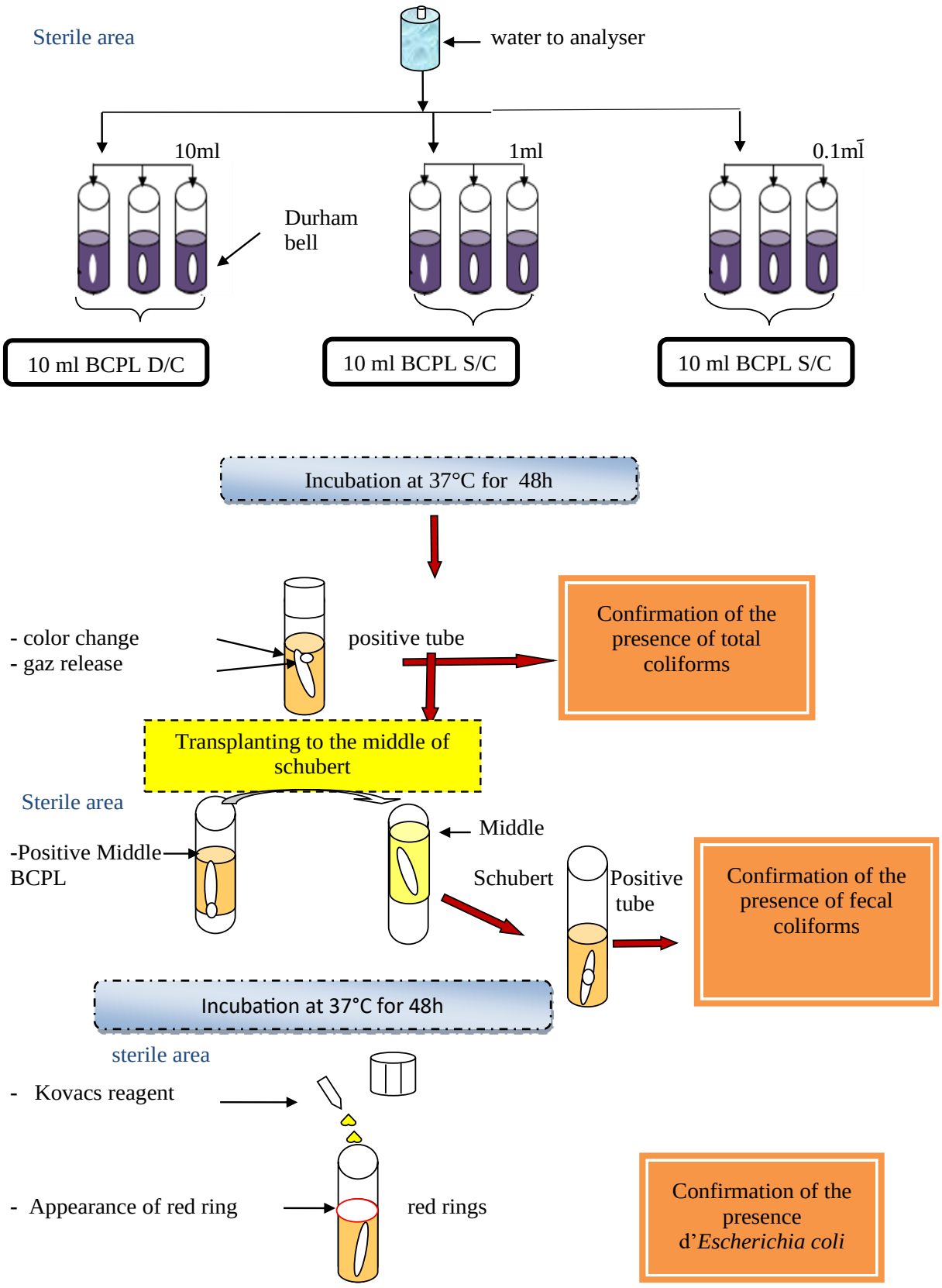

Figure 9: Explanatory diagram for the detection and enumeration of total, fecal coliforms and *Escherichia coli* in liquid media**.**

III.4.2.2. Research and enumeration of anaerobic sulfate-reducing bacteria

- **Principle**

The search for and enumeration of sulfito-reducing Clostridium spores makes it possible to highlight a group of anaerobic bacteria characterized by the resistance of their spores.

The isolation of these bacteria necessarily requires:

- Heating the water sample to 80°C for 10 to 15 minutes and sudden cooling (thermal shock) to destroy the vegetative forms of the bacteria and leaving the spores to persist (ISO 6461-2).

- **Method**

The steps of clostridium analysis are summarized as follows (fig.12)

- ✓ We flamed the upper surface of the filtration ramp then the porous plate;
- ✓ Afterwards we took the membrane;
- ✓ We placed it on the porous plate of the filtration ramp;
- ✓ We poured the quantity of water, then opened the tap to let the water flow,
- ✓ After drying the membrane, we took it and placed it upside down on the sterile Petri dish, paying attention not to trap any air bubbles, then we poured the VF agar onto the Petri dish;
- ✓ We incubated at 37°C for 48 hours, the Petri dishes, lid down;
- ✓ Reading is done on the Petri dish containing black colonies (ISO 646).

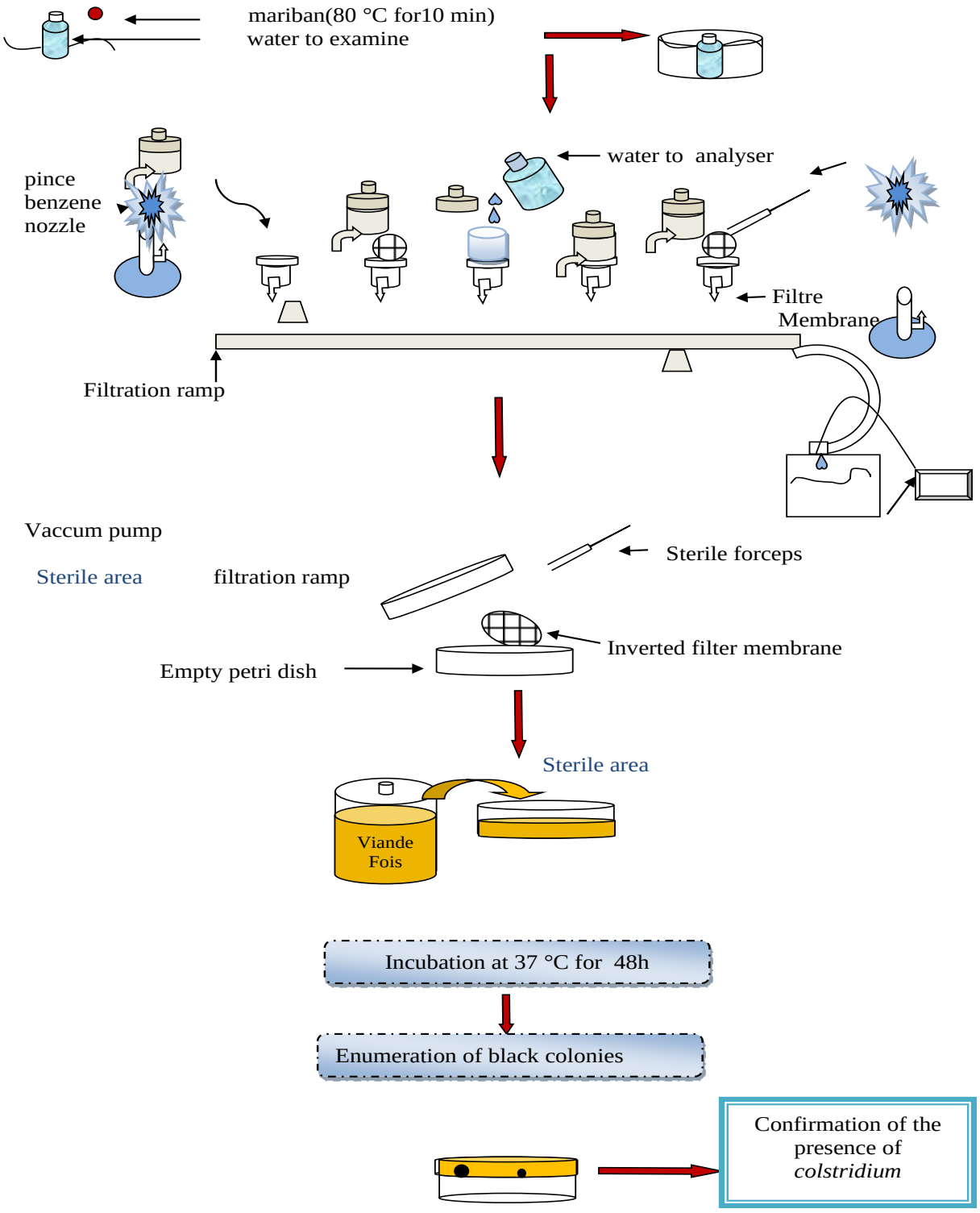

Figure 10: Enumeration of Clostridium.

III.4.2.3. Testing and enumeration of fecal *Streptococcus (Enterococcus*)

➢ **Material**

Mac Grady MPN table (most probable number).

Culture media and reagents

❖ 1 bottle of 50ml of Rothe's medium (double concentration sodium azide broth).
❖ 5 tubes of 10ml of double concentration Rothe medium.
❖ 5 tubes of 10ml of single concentration Rothe medium.
❖ Tubes of LITSKY medium (EVA) (Ethyl violet broth and sodium azide).

➢ **Method**

A. The presumptive test

From the raw water, we carried aseptically (fig.13).

✓ 5 tubes of 10 ml of double concentration Rothe's medium with 10 ml of water.
✓ 5 tubes of 10 ml of single concentration Rothe's medium with 1 ml of water.
✓ 5 tubes of 10 ml of single concentration Rothe medium with 0.1 ml of water.
✓ Then we moved on to incubation at 37°C for 48 hours.
✓ All tubes showing a microbial disorder are considered presumptive.

B. The confirmatory test

We put a few drops of Rothe's medium in Litsky's medium, then incubated at 37°C for 24 hours (fig.13).

The reading is taken after 24 hours, tubes showing a cloudiness at the bottom indicate the presence of fecal streptococci. We note the number of tubes in each series and we refer to the MPN table to obtain the number of streptococcus present in 100ml (Norme NF T90-411).

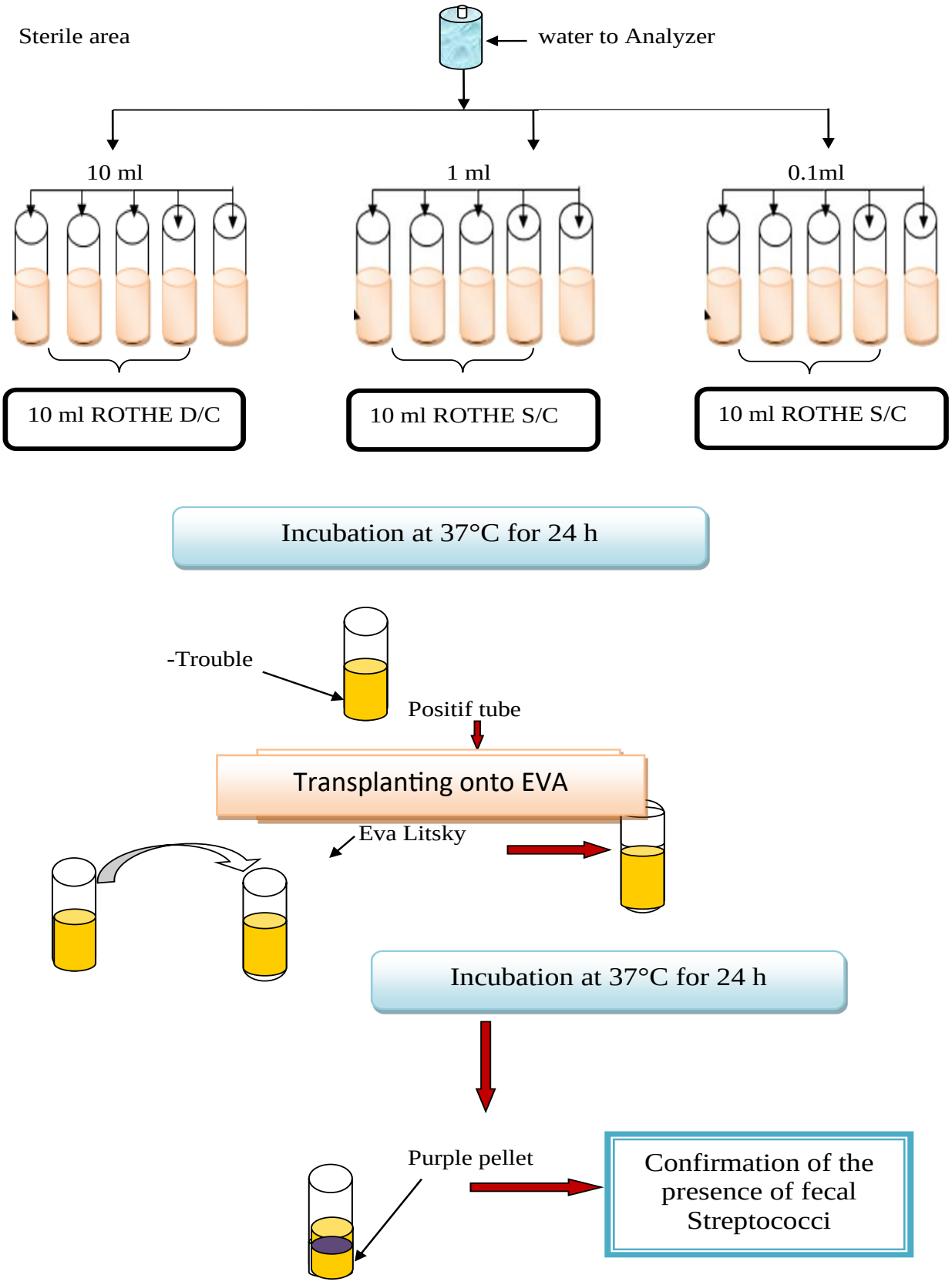

Figure 11: Explanatory diagram of the research and enumeration of fecal Streptococcus.

III.5. Physico-chemical analysis

III.5.1. Electrical conductivity, salinity and total dissolved solids

Conductivity is the ability of water to allow the passage of electric current. It varies depending on the temperature. Her determination is made using a multi-parameter (µS/cm) (Rodier,2009).

Salinity is defined as the sum of all substances dissolved in water. When its concentration is high, it influences the taste of the water and it is measured by multi-parameters with % (Rodier, 2009).

Total dissolved solids (TDS) in water (which is measured by multi-parameter (mg/l)) can affect its taste and certain components of TDS, such as chlorides, sulfates, magnesium, calcium and carbonates (Rodier, 2009).

III.5.2. Turbidity

Turbidity of water is caused by the presence of fine suspended matter. It is expressed in NTU and measured by a turbidimeter (Rodier, 2009).

III.5.3. pH

pH is one of the most important parameters in water quality. It is measured using a pH meter. (Rodier, 2009).

III.5.4. Temperature

Measured by a multi-parameter, temperature is the crucial physical parameter for assessing water quality. It plays a role in the solubilities of salts, gases and other materials: it influences electrical conductivity and pH (Rodier, 2009).

III.5.5. Oxygen

Dissolved oxygen (DO) is an essential parameter for assessing water quality and constitutes an excellent indicator of its condition. Measured using an oximeter, its value tells us about the degree of pollution in our waterways (Rodier, 2009)

III.5.6. Nitrate

Nitrates are found naturally in water sources, but excessive or poorly controlled use of nitrogen fertilizers can lead to increased nitrate levels in these resources (Idrissi, 2006).

➢ **Dosing principle**

This protocol specifies a sodium salicylate molecular absorption spectrophotometry method for the determination of nitrates in drinking water and raw water. In the presence of sodium salicylate, nitrates give sodium paranitrosalicylate, colored yellow (Rodier, 2009).

➢ **Method**

We have used the method of Rodier (2009).

All glassware washed with HCL solution and rinsed with distilled water before use.

- ✓ 10 ml of sample was taken in a 60 ml capsule, and it was alkalized with 3 drops of the sodium hydroxide solution, then 0.5 ml of the sodium azide solution and 0.2 ml were added. concentrated acetic acid;
- ✓ After 5 minutes, the dry mixture was evaporated in an oven heated to 80°C;
- ✓ Afterwards, 1 ml of the sodium salicylate solution was added, and it was homogenized and evaporated to dryness again;
- ✓ Then the capsule was removed and allowed to cool to room temperature.
- ✓ And 1 ml of sulfuric acid was added to dissolve the residue in the capsule by stirring lightly;
- ✓ The mixture was left to stand for approximately 10 minutes, then 15 ml of distilled water and 10 ml of the sodium hydroxide solution which develops the yellow color were added;
- ✓ Then we read the spectrophotometer at a wavelength of 415 nm. (Concentrations in mg/l of Nitrate (NO3-) are displayed directly on the spectrophotometer) (Rodier, 2009).

III.5.7. Ammonium (NH^{4+})

Ammonium is a reliable indicator of water pollution from organic sources such as agriculture, industry and domestic waste. Its presence in water is generally the result of an incomplete decomposition process of organic matter. It is also produced by the reaction of nitrates with iron-containing minerals (Djadouni, 2017).

➢ **Dosing principle**

The determination of ammoniacal nitrogen is carried out by spectrometric measurement at 655 nm of the blue compound formed by reaction of ammonium with salicylate and hypochlorite ions in the presence of nitrosopentacyanoferrate.

➢ **Method**

All glassware should be thoroughly washed with the washing solution and rinsed with ammonium-free water before use. (Appendix II)

- ✓ We have took 40 ml of sample (raw water) through a burette and poured it into a 50 ml volumetric flask;
- ✓ 4 ml of the colored reagent were added using a pipette into the vial containing the sample, then homogenization was carried out,
- ✓ 4 ml of the sodium dichloroisocyanurate solution were added and then homogenized well;
- ✓ Then we made up the volume to 50 ml with ammonium-free water and left it to stand for at least 60 minutes;
- ✓ The reading was taken with a spectrophotometer. The result is expressed by mg/l (ISO 7150).

Blank test

Carry out a blank test in parallel with the dosage by proceeding as described in the method, replacing the test portion with 40 ml of ammonium-free water. (We use the blank because it is required first in the spectrophotometer to pass the other sample to measurement).

III.5.8. Nitrite (NO^{2-})

Nitrites, present naturally in the environment, are very toxic and are quickly and naturally oxidized into nitrate ions.

- ➢ **Dosing principle**

Reaction of nitrite ions present in a test portion in an acidic medium (pH 1.9), with the 4-amino benzen sulfonamide reagent in the presence of ortho phosphoric azide to form a diazo salt which forms a pink coloring complex with the dichlorohydrate of N-(1-naphthyl)1.2-diaminoethane ($C_{12}H_{16}C_{l2}N_2$). Which is measured at the absorption wavelength λ= 540 nm (ISO 6777; NA1657).

- ➢ **Method**

All glassware washed with HCL solution and rinsed with distilled water before use.

- ✓ 40 ml of sample (raw water) were poured into the 50ml volumetric flask.
- ✓ Then 1 ml of the colored reagent was added to the vial and mixed well.
- ✓ Make up to 50 ml with distilled water and homogenize.
- ✓ We left it to rest for at least 20 minutes.
- ✓ The reading was taken with a spectrophotometer at a program number: 9010, and cell type 1cm (ISO 6777; NA1657).

Blank test

Carry out a blank test in parallel with the dosage by proceeding as described in the method, replacing the test portion with 40 ml of distilled water (ISO 6777; NA1657).

III.6. Bacteriology of fish

After bringing a fish sample back to the laboratory in a cooler to preserve it and avoid any contamination (MacWilliams, 2006).

Send to the figure below (fig.12).

- ✓ In a sterile area, the fish surface was rinsed with Luria Bertani broth;
- ✓ Using sterile swabs, we inoculated the surface, the gills, the anal part, the mouth and the fins, then we immersed them in their tubes containing the LB broth ;
- ✓ The fish was emptied of its viscera, then the organs were placed separately in different Petri dishes containing Luria Bertani broth;
- ✓ A small portion of each fish organ was placed in Eppendorf tubes filled with Luria Bertani broth;
- ✓ The Eppendorf tubes and swabs were incubated at 37°C for 48 hours, after incubation they were placed in the refrigerator until us.

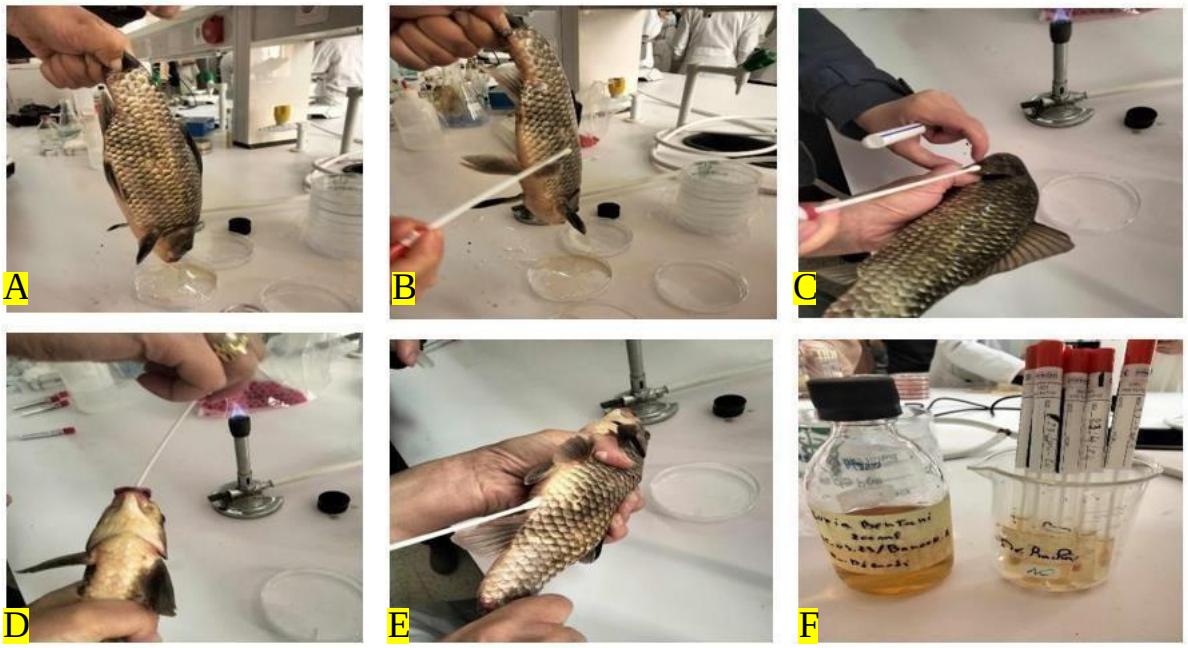

Figure 12: the stages of seeding: A) rinsing the surface; B) surface seeding; c) seeding on the gills; D) seeding in the mouth; E) seeding in the anal part (original).

- ✓ To carry out the isolation of bacteria, these selective media were prepared (EMB, McC, MSA, MRS). **(**Appendix III**)**
- ✓ From the stock solution of the samples we prepared a dilution series (10^{-1} and 10^{-2}) in Eppendorf tubes at a rate of 100 µL complete per 1ml of physiology water;
- ✓ Afterwards, 100 µL of each Eppendorf tube prepared at a dilution of 10^{-2} was poured into Petri dishes containing the different selective media (EMB, MCc, MSA, MRS), stirring the Petri dishes to propagate all the quantity poured over the entire surface of the agar. Then all the Petri dishes were incubated at 37°C for 24 hours;
- ✓ After having several colonies we moved on to the purification step, by preparing the same selective media again, then inoculating the latter with pure colonies in tight streaks, then incubating them at a temperature of 37°C for 24 hours (MacWilliams, 2006).

Chapter IV

Result and discussion

IV.1. Results of bacteriological analyzes

Our results indicate the presence of germs indicative of fecal contamination:

- ✓ Total germs
- ✓ Total coliforms.
- ✓ Fecal coliforms (thermotolerant).
- ✓ Fecal streptococcus.
- ✓ Anaerobic sulphite-reducing (ASR) bacteria

The table above represents the results of bacterial enumeration of TILESDIT dam water during the study period.

Tableau 2: Bacteria enumeration results.

Sampling date	C. Total MPN/ml	C. fecal MPN/ml	*E. coli*	S.Fecal MPN/ml	GT at 37 C/ml	GT at 22 C/ml	Clost C/ml
02/25/2024	4800	149	00	21	15	10	18
03/10/2024	918	109	4	33	128	284	42
04/07/2024	35	00	00	00	120	57	1

MPN: most probable number.

GT: total germ.

NC: characteristic number.

This table shows the number of different fecal contamination germs during the study period. It was noted that in the month of February, total coliforms are the most abundant with a number of 4800MPN/ml with the total absence of *E. coli*. In the month of March, we still noticed the abundance of total coliforms (918MPN/ml), and the presence of *E. coli* with a number of 4MPN/ml. In April, the highest value was recorded in total germs at 37°C (120MPN/ml), with the total absence of fecal coliforms, *E. coli* and fecal *Streptococcus*.

IV.2. Research result and count of total germs

Figure 13, showed that the number of total germs incubated at 22°C is 10GT/ml in February, 284CFU/ml in March and 57GT/ml in April.

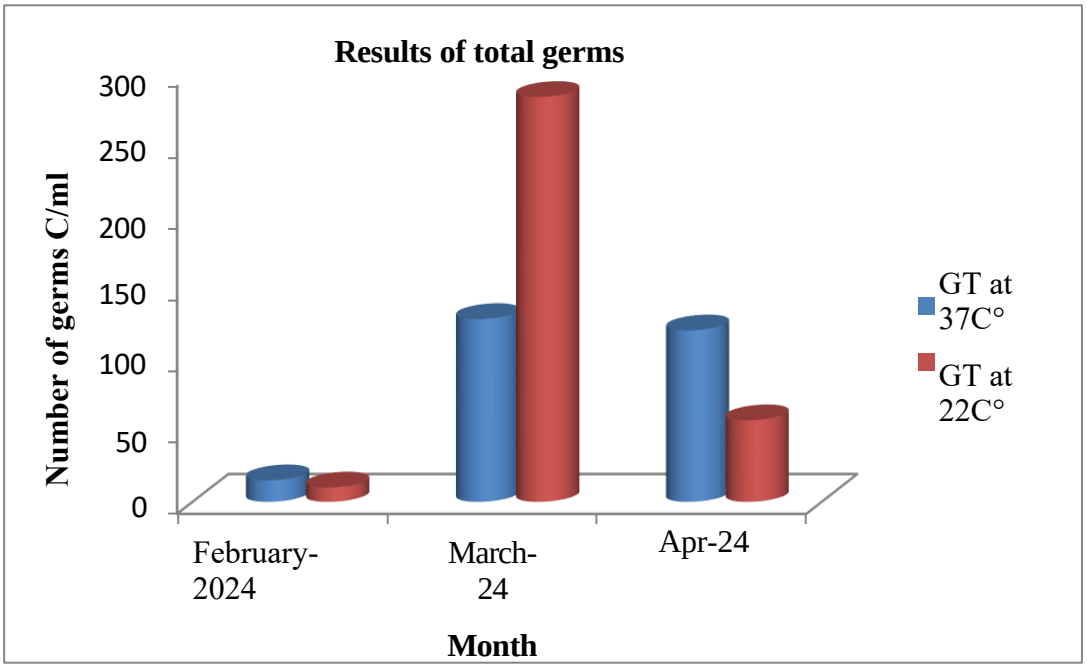

Figure 13: The evaluation of the number of total germs at 37C°, at 22C°.

Our results, presented in Figure 13, showed that the number of total germs incubated at 22°C is 10GT/ml in February, 284CFU/ml in March and 57GT/ml in April.

For the germs incubated at 37°C, more or less different levels were recorded, reporting a minimum value of 15GT/ml during the month of February, and a maximum value of 128GT/ml during the month of March.

These variations are probably due to heavy precipitation, the influence of temperature on the growth of these microorganisms and that waters are exposed to various sources of contamination which differ from one place to another.

These results differ from those reported by Barour et *al*. (2012), where the number of total germs found during the months of April and September is 336GT/ml and 500GT/ml respectively.

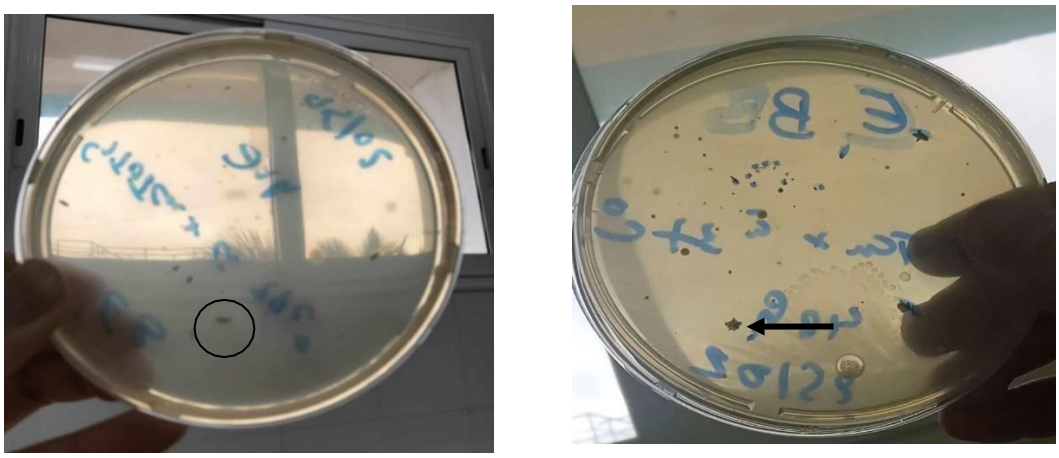

Figure 14: Results of total germs (original).

IV.2.1. Detection and enumeration of total coliforms (CT)

According to the results obtained in Figure 15 , we observed a very high contamination by total coliforms (4800CT /ml) in the month of February. A decrease is recorded from March (918CT/ml) to April 35CT/ml). These results reflect the presence of fecal contamination of human and animal origin.

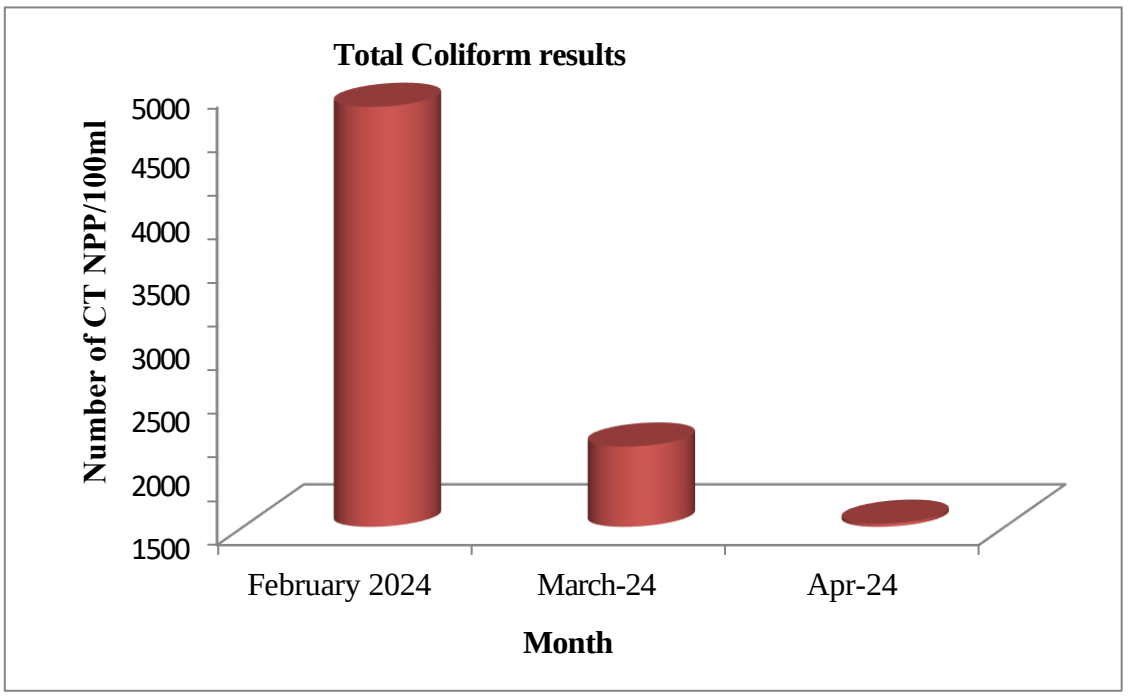

Figure 15: Evaluation of the number of total Coliforms.

On the other hand, Barour et *al.* (2012) reported a high load during the months of April and September at the level of Oued Medjerda**.**

IV.2.2. Testing and enumeration of fecal coliforms (CF)

A presence of fecal coliform contamination was observed at a reduced rate over the two months: February (149CF/100ml) and March (109CF/100ml), but absent in the month of April (figure 16). The presence of fecal coliforms indicates fecal pollution, and their absence can be explained by the absence of bacterial contamination of fecal origin. And this is even observed by the absence of *E. coli* in the months of February, April and its presence in the month of March with a low rate.

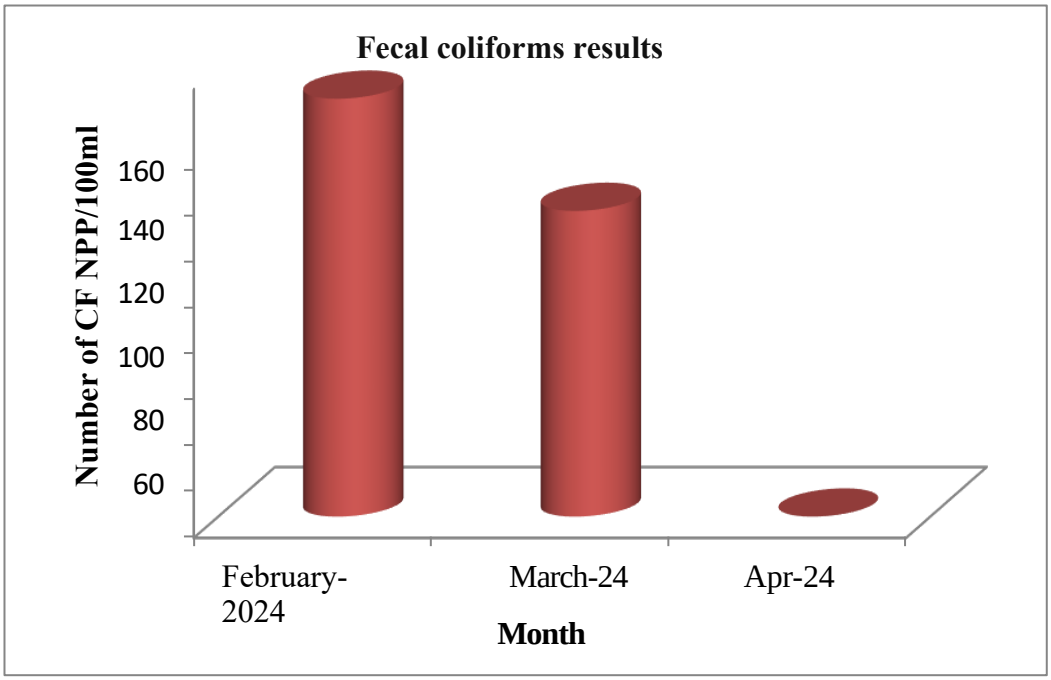

Figure16 : Evaluation of the number of fecal coliforms.

These results do not agree with the results found in Wadi Medjerda by Barour et *al*. (2012), Orthey showed very strong contamination during the two study periods, April (140x102 /ml) and September (140x102 /ml). We can say that the raw water from the TILESDIT dam is good for consumption, but after completion of the treatments. Given the absence of contaminating bacteria, the treatment is easy to carry out; in fact, the number of CF was reduced to the point of disappearance throughout the observation period; this water is therefore of good quality.

IV.2.3. Investigation and enumeration of fecal streptococcus

Figure 17 shows that the highest values of fecal *Streptococcus* were recorded in the month of March (33 SF/ml) but absent in the month of April. Indeed, we can say that this water is of good quality.

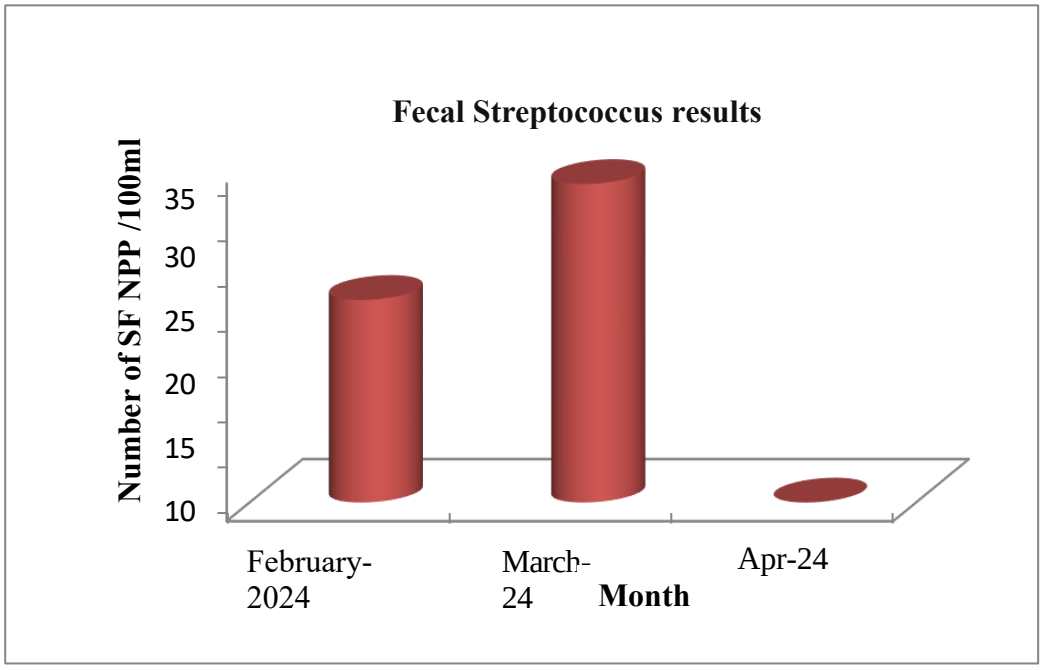

Figure17: Evaluation of the number of fecal *Streptococcus*.

The results found in Oued Medjerda by Barour et *al.* (2012), show fecal contamination of human origin during the two study periods, April (140x102 /ml), September (140x102 /ml).

According to Barour et *al.* (2012), fecal *Streptococcus* are usually present in feces, mainly of human origin. Their numbers vary, generally much lower than those of other fecal contamination indicator microorganisms in water, and are directly proportional to the amount of fecal matter present...

IV.2.4. Research and enumeration of anaerobic sulphite-reducing bacteria

Figure 18 shows the presence of black halos in Petri dishes containing meat-liver (VF) medium, which explains the presence of sulphite-reducing anaerobes. 18 ASR/100ml were recorded in the month of February, 42 ASR/100ml in the month of March and 1ASR/100ml in April (fig. 20).

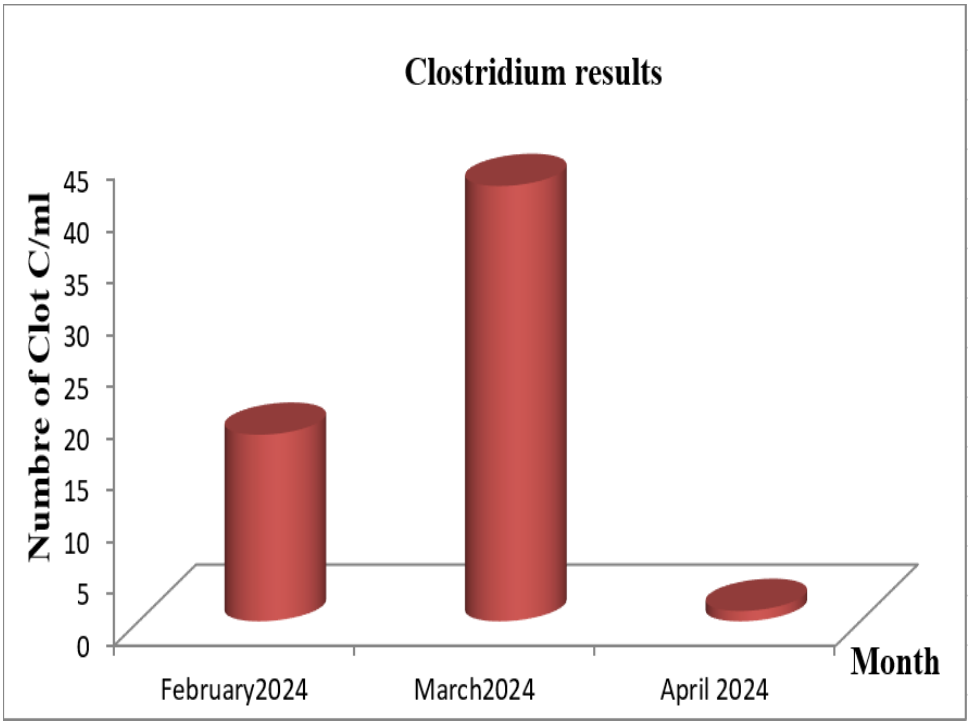

Figure 18: Evaluation of the number of sulphite-reducing anaerobes (*Clostridium*).

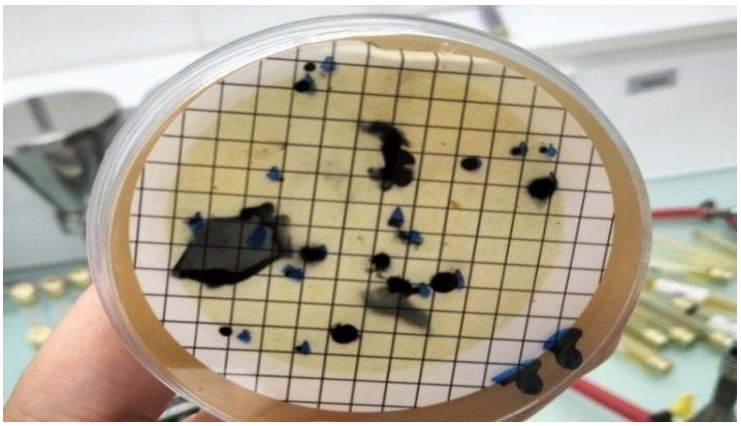

Figure 19: Results of Anaerobic sulphite-reducing spores (original).

Our results are in agreement with those of Barour et *al*. (2012). Which means the presence of old contamination, and the water is not completely protected against the irruption

of foreign bacterial flora of fecal origin in the first two months. In April, the ASR load is lower, which confirms that Tilesdit dam water is affordable for treatment.

IV.3. Results and physicochemical discussions

IV.3.1. Potential of Hydrogen (pH)

Figure 20 represents the pH values of the raw water from the Tilesdit dam during the study period.

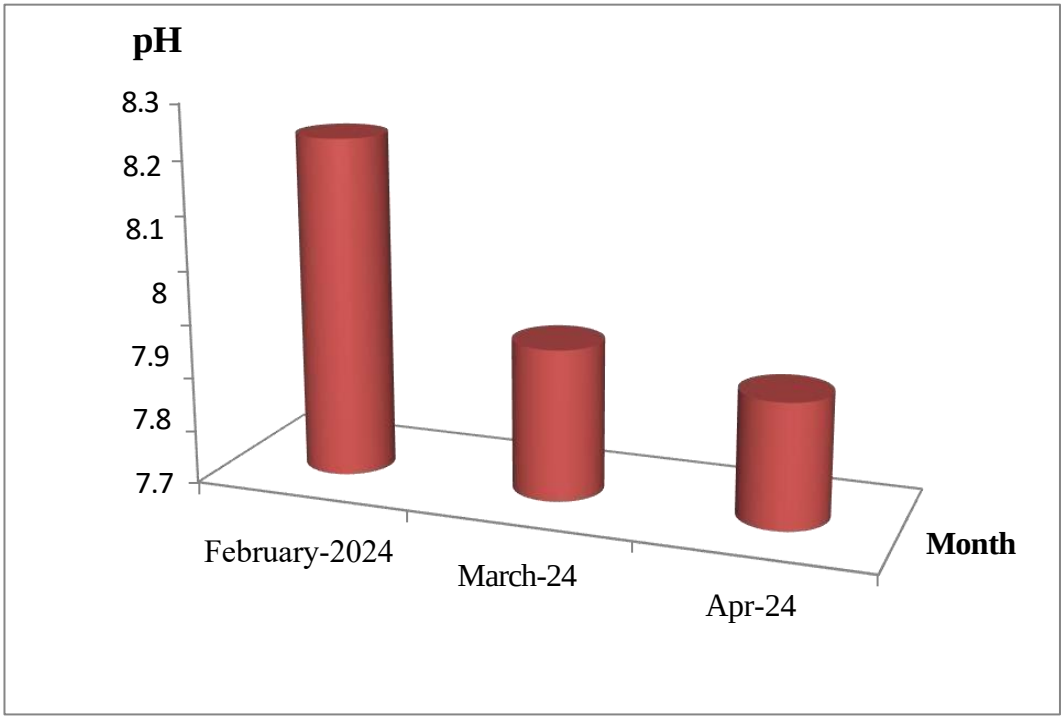

Figure 20: Variations in Potential of Hydrogen.

According to the results obtained, the observed values reveal that the pH of the raw water from the Tilesdit dam is slightly neutral to alkaline, because the absence of a source of pollution during the study period such as: waste, waste...

Figure 20 shows that the pH varies between 8.23 (maximum value in the month of February) and 7.83 (minimum value in the month of April). These results are very close to those obtained by Djadouni (2017) in the raw water of the Bouhanifia dam in Mascara (Western Algeria), where it reported a maximum value of 8.25 in the month of February.

While, the water from the Bab louta dam is characterized by a maximum value of 8.2 recorded during the month of February (Achmit et *al*., 2017).

IV.3.2. Temperature

Figure 21 shows the raw water temperature values of Tilesdit Dam during the study period.

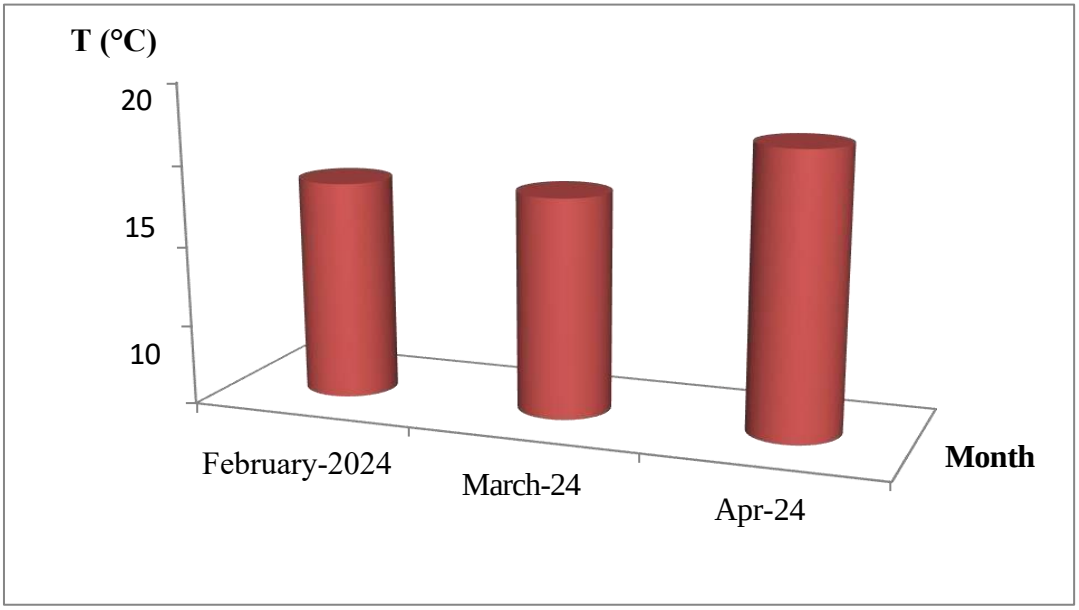

Figure 21 : temperature variations.

According to the results obtained, we observe that the water temperature of the Tilesdit dam increases gradually from February (13.6°C) to April (17.4°C) (figure 23). The dam temperature is probably varied depending on the different climatic seasons, climate of the region, depths (Makhoukh et *al*., 2011.Chaibi,2014**)**

These results differ from those reported by: Djadouni (2017)**,** where the upper value of the temperature of the Bouhanifia dam recorded during the month of April is 20°C. This difference may be due to the heavy precipitation in April 2024, and probably to the different climate of the two regions.

IV.3.3. Electrical conductivity

Figure 22 represents the raw water conductivity values of the Tilesdit dam during the study period.

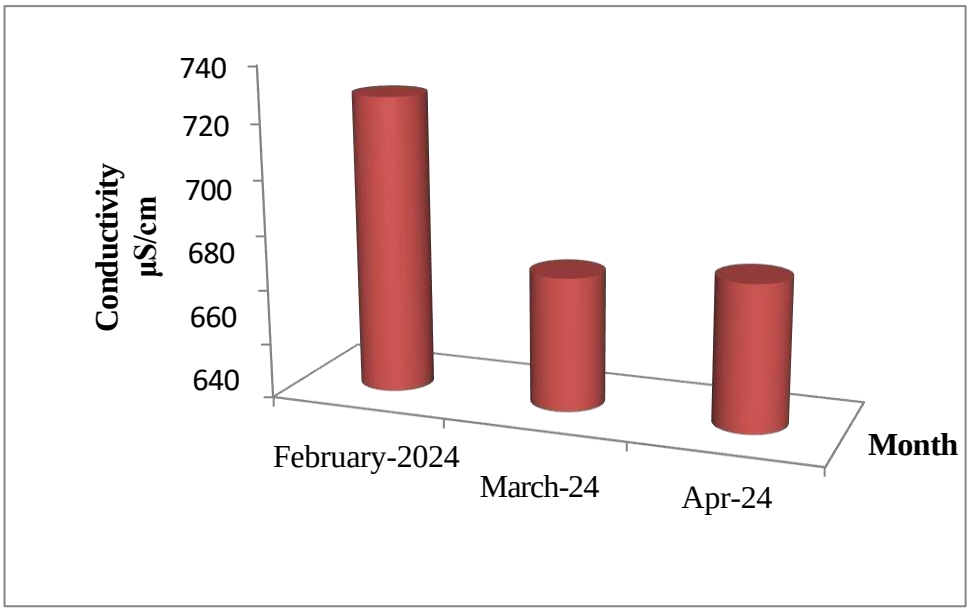

Figure 22: Variations in electrical conductivity values**.**

According to the results obtained from the water of the Tilesdit dam figure 24, we noted that the electrical conductivity is decreasing (February: 728 µS/cm, March: 668µS/cm and April: 673µS/cm), this decrease can be translated by the absence of anthropogenic activities which affects the variation in electrical conductivity.

Whereas, the water from the Bouhanifia dam is characterized by high electrical conductivity (the maximum value is 1600µS/cm recorded in February). (Djadouni, 2017**).**

IV.3.4. Turbidity

Figure 23 shows the raw water turbidity values of Tilesdit Dam during the study period.

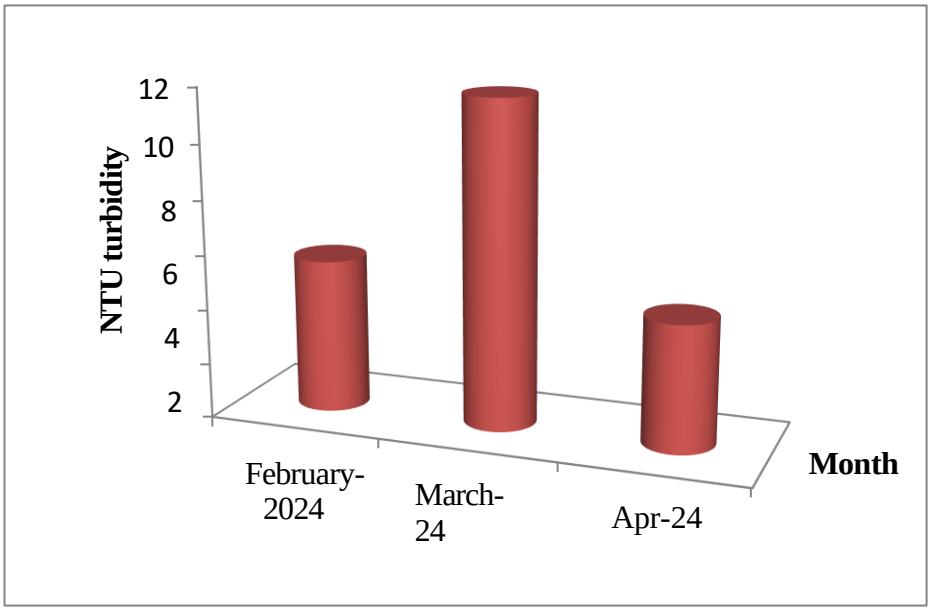

Figure 23: Variations in turbidity values.

According to our results, the turbidity values of the raw water from the Tilesdit dam vary between 11.87 NTU (maximum value) recorded in the month of March and 4.6 NTU (minimum value) recorded in the month of April.

These results are weak compared to those reported by Djadouni (2017), where the maximum value of turbidity recorded is 15NTU in the month of February.

The high turbidity values are probably due to the presence of suspended matter in the water (clay, organic debris, microscopic organisms, etc.) (Makhukh et *al.*, 2011**)**.

IV.3.5. Salinity

Figure 24 represents the salinity values of the raw water from the tilesdit dam during the study period.

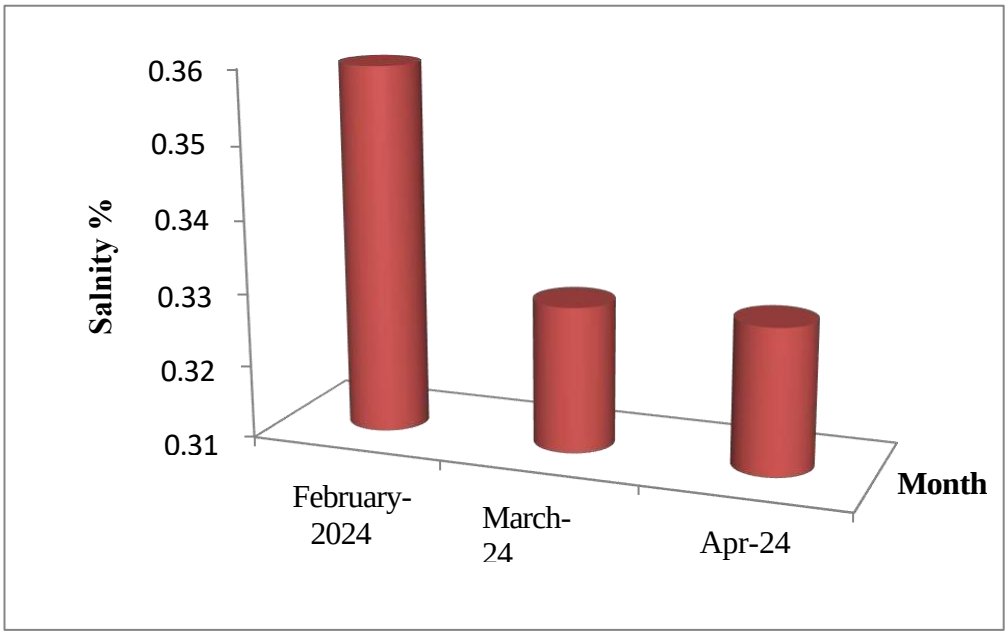

Figure 24: Salinity variations.

According to the results obtained (figure 24), the salinity values of the raw water from the Tilesdit dam vary between 0.36% (month of February) and 0.33% (month of March and April).

Our results are comparable to those found by Moali (2009), or the highly salty water of Oued Soummam.

IV.3.6. Dissolved oxygen (DO)

Figure 25 shows the dissolved oxygen values of raw water from Tilesdit Dam during the study period.

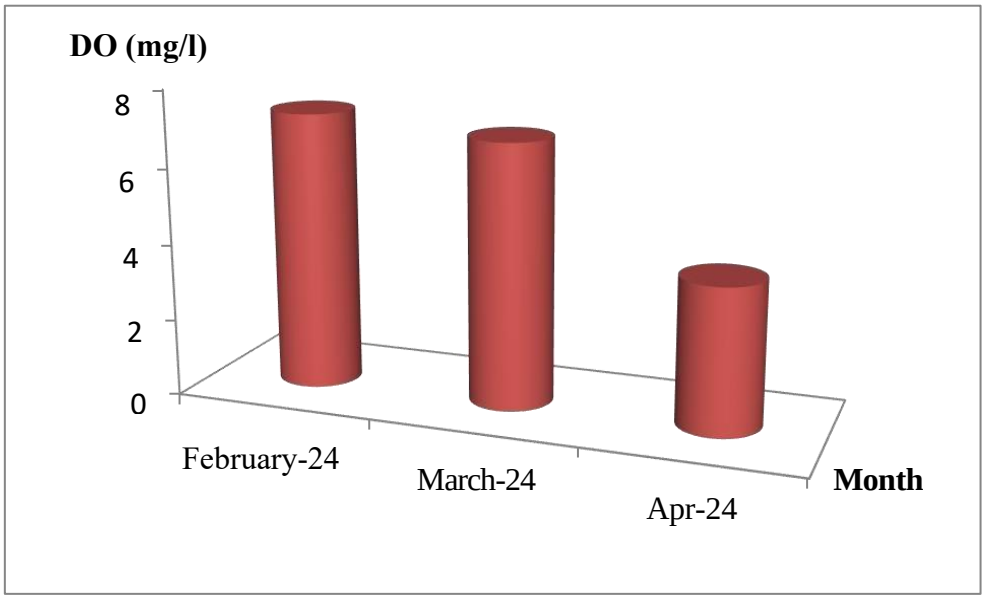

Figure 25: Changes in dissolved oxygen.

According to the results obtained (figure 25), we note that the values of dissolved oxygen recorded at the Tilesdit dam vary between 7.28 mg/l in the month of February and 3.81 mg/l recorded in the month of April.

The decrease in dissolved oxygen values may be due to the increase in dam water temperature during the study period, because the higher the temperature, the more the dissolved oxygen in the water decreases as well as the quality of dissolved oxygen in cold water is greater than hot water (Makhoukh et *al.*, 2011).

The dissolved oxygen values recorded in the water of the Foum EL-Khanga dam in Souk-Ahras are very high values during the study period by supplying water from the Tilesdit dam (the maximum value is 9mg/l in month of February) (Allalgua et *al.*,2017).

IV.3.7. Total Dissolved Solid (TDS)

Figure 26 shows the TDS values of raw water from Tilesdit Dam during the study period.

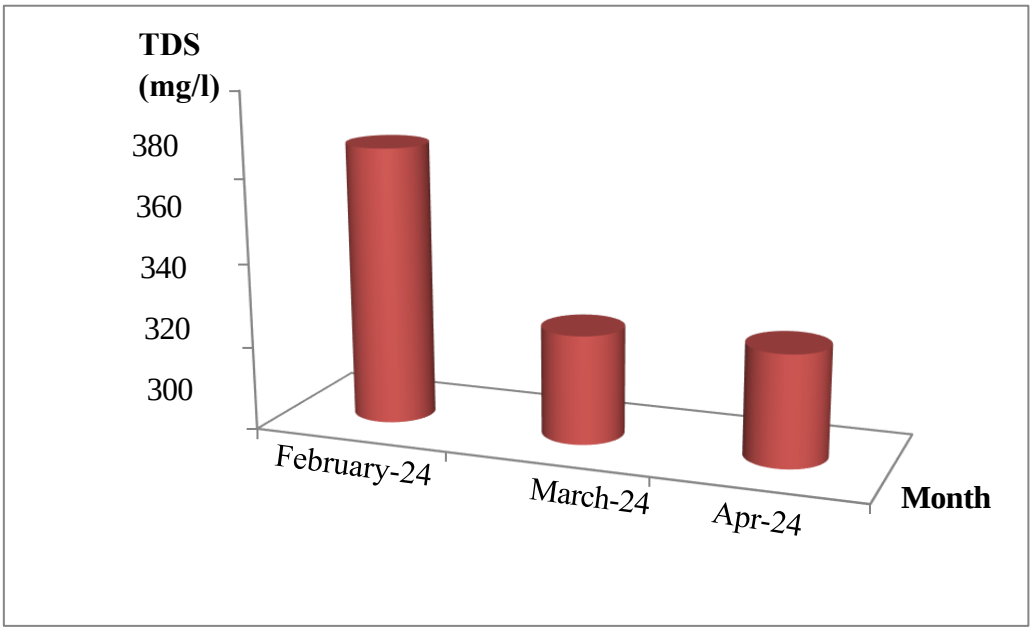

Figure 26: Variations in total dissolved solids.

From the results obtained (figure 26), we note that the TDS values of the raw water from the Tilesdit dam vary between 366 mg/l recorded in the month of February, 325.90 mg/l in the month of March and 326, 45mg/l in April.

Our results are comparable to those found by Boudjenah (2022), where the maximum value recorded during the study period in the Boukordane dam in Tipaza is 437.08 mg/l.

So, we can say that the raw water from the Tilesdit dam is of good quality during the study period.

IV.3.8. Nitrate NO^{3-}

The Tilesdit Dam raw water Nitrate values are shown in Figure 27.

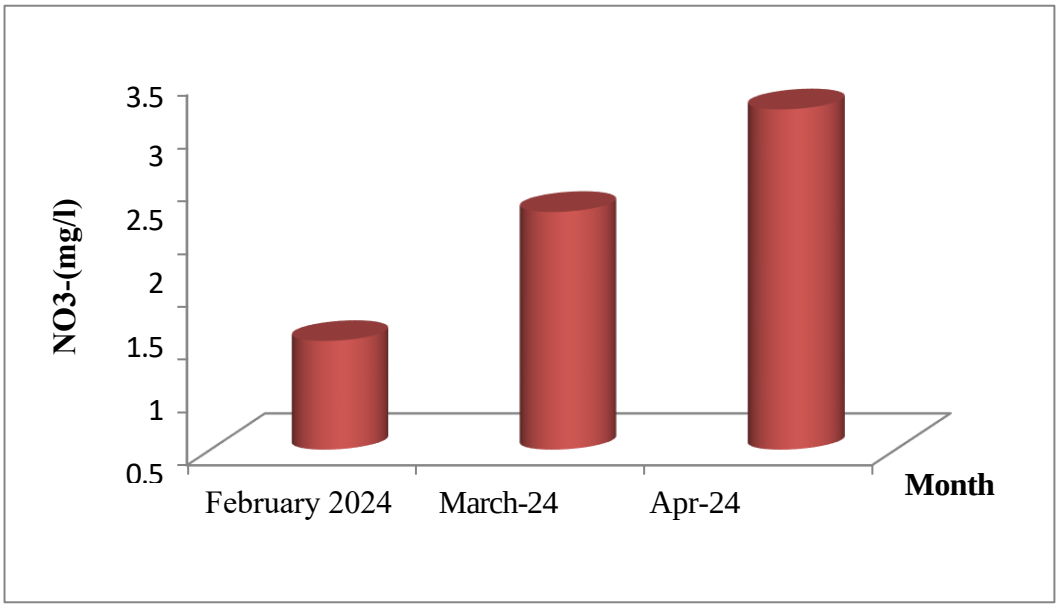

Figure 27: Variations in Nitrate values.

According to Figure 27, the Nitrate values in the raw water of the Tilesdit dam are increasing from 1.03mg/l (in the month of February) to 3.22mg/l (in the month of April).

The increase in nitrate values in the raw water of the Tilesdit dam during the month of April compared to the other month may be due to the leaching of fertilizers (fertilizers) used in agricultural soils located on the edges of the dams or valleys (Makhukh et *al*., 2011).

These results differ from those reported by Djadouni (2017), where the maximum value recorded during the study period in the Hanifia dam is 13mg/l in the month of March.

IV.3.9. Ammonium NH^{4+}

Figure 28 represents the values of Ammonium in the raw water of the Tilesdit dam during the study period.

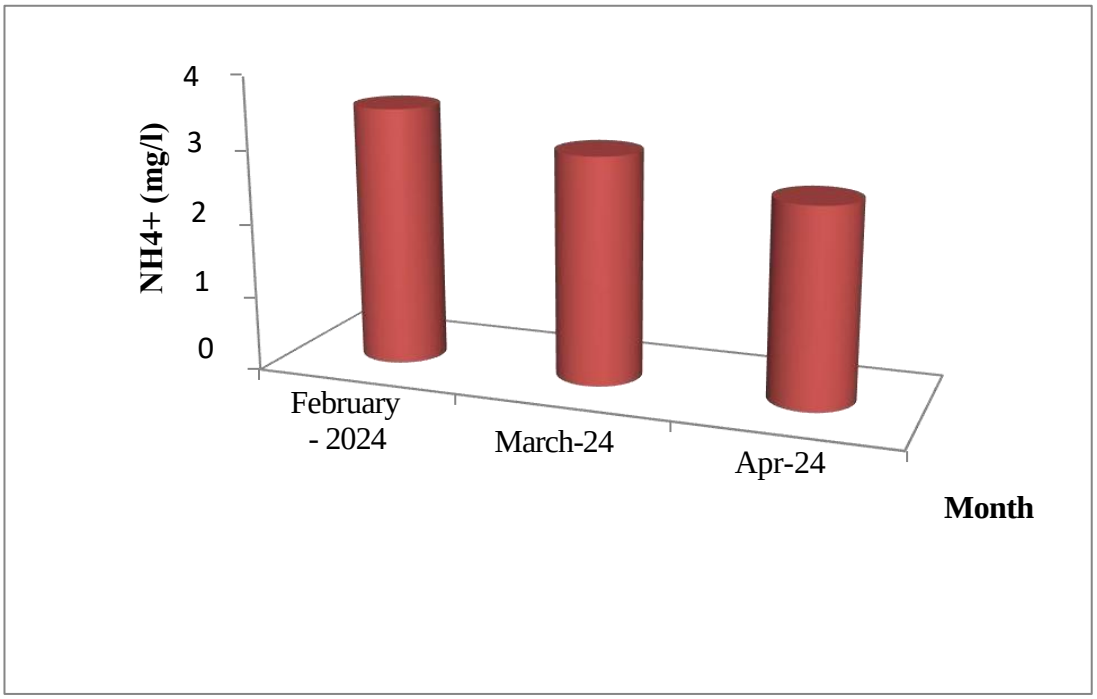

Figure 28: Variations in Ammonium values.

According to the results obtained (figure 28), the ammonium values recorded during the study period are decreasing between the month of February (3.53 mg/l) and the month of April (2.68 mg/l), this reduction reflects the leaching processes of the agricultural land surrounding the dam.

While the ammonium values recorded in the water of the BOUHANIFIA dam are very reduced values; 0.6 mg/l (in the month of February), 1.1 mg/l (in the month of March) and 1.2 mg/l (in the month of April) by intake of raw water from the Tilesdit dam (Djadouni, 2017).

High ammonium values may be due to the presence of a source of pollution such as wastewater, waste, pesticides for example (Makhukh et *al*., 2011).

IV.3.10.Nitrite NO^{2-}

Figure 29 shows the Nitrite values of the raw water from the Tilesdit dam during the study period.

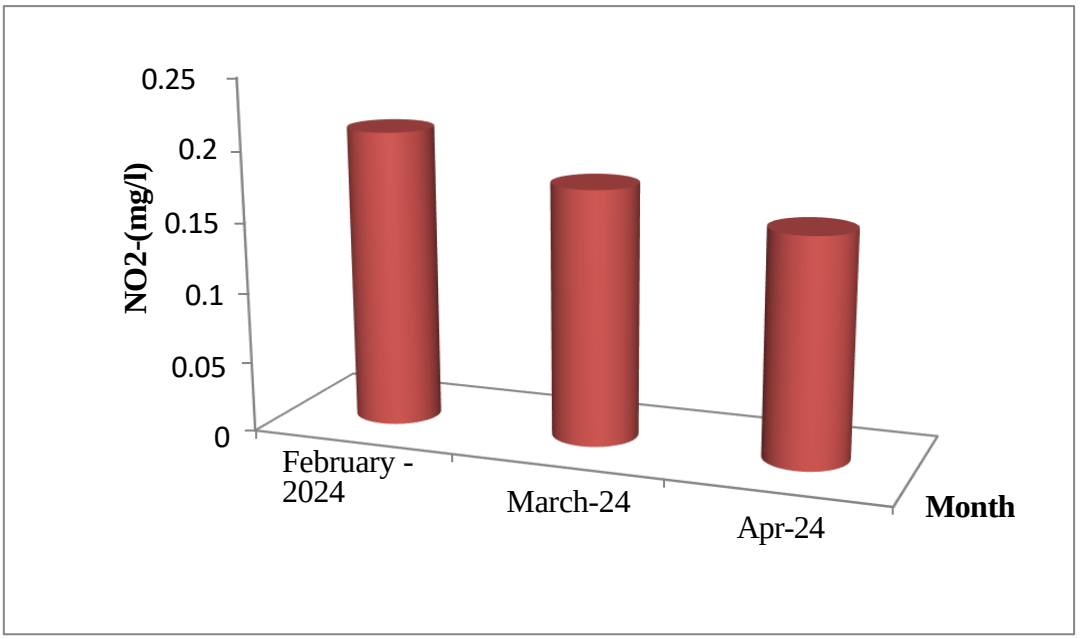

Figure 29: Variations in Nitrite values.

According to the results illustrated in figure 29, we note that the Nitrite values recorded in the water from the Tillesdit dam vary between 0.21 mg/l in the month of February and 0.16 mg/l in the month of April.

Waters containing Nitrite are suspect waters, because the presence of Nitrite ions causes the deterioration of the microbiological quality of the water (Makhukh et *al*., 2011).

Our results differ from those reported by Djadouni (2017)**,** where the maximum value of Nitrite recorded in the month of April is 0.75 mg/l.

- According to the Assessment Grid, the quality of the water from the Tilesdit dam was determined based on the parameters studied (table 02).

Tableau 3: The water quality assessment grid.

The parameter	Water quality		The quality of raw water from Tilesdit dam during the study period
Potential of Hydrogen (pH) (Zerluth, 2024).	7 <pH < 8	Approximate neutrality	Raw water from the Tilesdit dam is of excellent quality
	pH=8	pH neutral	
Temperature(°C) (Monod, 1989).	< 20°C	Normal	Raw water from the Tilesdit damis of excellent quality
	20°C – 22°C	Good	
Conductivity (µS/cm) (Potelon et Zysman, 1993)	400 <CE< 600	Good	The quality of raw water from Tilesdit Dam is excellent.
	600 <CE< 1000	Usable	
Turbidity (NTU) (Hakimi,2002).	NTU<5	Clear water	The water from the Tilesdit dam is slightly cloudy.
	5 <NTU<30	Slightly cloudy water	
Salinity (%) (Chevallier, 2007).	Less than 0.5%	Fresh waters	The water from the Tilesdit dam is apure water.
	0.5 to 5 mg/l	Oligohaline waters (Slightly brackish)	
Dissolved oxygen (DO) (mg/l) (Rodier, 1976).	Between 1 and 2 mg/l	Suspicious waters	Raw water from the Tilesdit dam is of poor quality.
	More than 4 mg/l	Bad water	
Nitrates (mg/l) (ANRH, 2001).	NO3- < 10	Good	The quality of raw water from Tilesdit dam is of good quality
	10 <NO3-< 20	Average with sign of Pollution	
Ammonium (mg/l) (ANRH, 2001).	1.54 <NH4+< 6.2	Poor	Raw water from the Tilesdit dam is of poor quality.
	NH4+>6.2	Bad	
Nitrite (mg/l) (ANRH, 2001).	0.1<NO2-<0.3	Good	Dam water quality Tilesdit is of good quality
	0.3 <NO2-< 1	Fair	

IV.4. Results of bacteriological analyzes of fish

The tables above represent the results of bacteria identified in different body parts of TILESDIT dam fish.

Tableau 4:Results of bacteria identified in EMB medium.

Organ	EOSIN METHYLENE BLUE AGAR (EMB)						
	Coded	Appearance	Size	Color	Shape	Translucent	Strain
Fin	Nag1	Mucosa	Small colonies	Pink	Round	Yes	*Klebsiella pneumoniae*
	Nag2	Mucosa	Small colonies	Pink	Round	Yes	*Klebsiella pneumoniae*
Gonad	No strain appeared						
Gill	B1	Mucosa	Average	Pink	Round	Yes	*Klebsiella pneumoniae*
	B2	Mucosa	Average	Pink	Round	Yes	*Klebsiella pneumoniae*
	B3	Mucosa	Small colonies	Pink	Round	Yes	*Klebsiella pneumoniae*
Scale	No strain appeared						
Mouth	B1	Mucosa	Small colonies	Mauve	Round	No	*Enterobacter*
	B2	Mucosa	Small colonies	Mauve	Round	No	*Enterobacter*
Swim bladder	No strain appeared						
Liver	No strain appeared						
Anal	A1	Mucosa	Big	Pink	Round	Yes	*Klebsiella pneumoniae*
Left Surface	SG1	Creamy	Small colonies	Mauve	Round	No	*Enterobacter*
	SG2'	Creamy	Small Colonies	Mauve	Round	No	*Enterobacter*
	SG2"	Mucosa	Small colonies	Metallic green	Round	Yes	*E.coli*
	SG3	Mucosa	Small colonies	Mauve	Round	No	*Enterobacter*
Intestine	IN 1	Mucosa	Small colonies	Mauve	Round	No	*Enterobacter*
Surface of Pisces	SP1	Mucosa	Small colonies	Mauve	Round	No	*Enterobacter*
	SP2	Mucosa	Small colonies	Mauve	Round	No	*Enterobacter*
	SP3	Mucosa	Small	Mauve	Round	No	*Enterobacter*

			colonies				
	SP4	Mucosa	Small colonies	Mauve	Round	No	*Enterobacter*
Right Surface	SD1	Mucosa	Small colonies	Mauve	Round	No	*Enterobacter*
	SD2	Mucosa	Average	Mauve	Round	No	*Enterobacter*
	SD3	Mucosa	Average	Mauve	Round	No	*Enterobacter*
	SD4	Mucous membranes	Small colonies	Metallic green	Round	Yes	*E.coli*

The table shows the results of bacteria identified in EMB medium in different fish organs. Our observations of the strains present on the fins of fish in EMB environment reveal characteristics such as roundness, translucency, their mucous appearance, small colonies and a pink color. Comparing our results to others (Michael, 2012), it seems likely that the strains we identified are *Klebsiella pneumoniae*.

The same strains as those observed in the fins were identified in the gill, the only distinction being the size of strains 1 and 2, which is medium. The strains present in the mouth have mucous characteristics, round, opaque, small colonies, with a purple color for B1 and B2. Our results agree with those of Michael (2012), which identified *Enterobacter*.

The results of the analysis of the anal are comparable to those of the fins, with the exception of the size, which is larger for the anal. On surface G, we identified three types of strains. Strains SG1 and SG3 exhibit the same characteristics found in the mouth, the only difference being the creamy texture of SG1. SG2', while SG2" presents a new strain in agreement with the results of Archana (2017) (*E. coli*), is characterized by its mucous texture, its small colonies, its metallic green color, its round shape and its translucency.

Strains found in the intestine and on surfaces P and D, with the exception of SD4, are identical to those in the mouth and are opaque rather than translucent, and SD2 and SD3 are medium in size. SD4, for its part, contains strains of *E. coli* with similar characteristics to SG2". No strains appeared in the gonads, liver and scales.

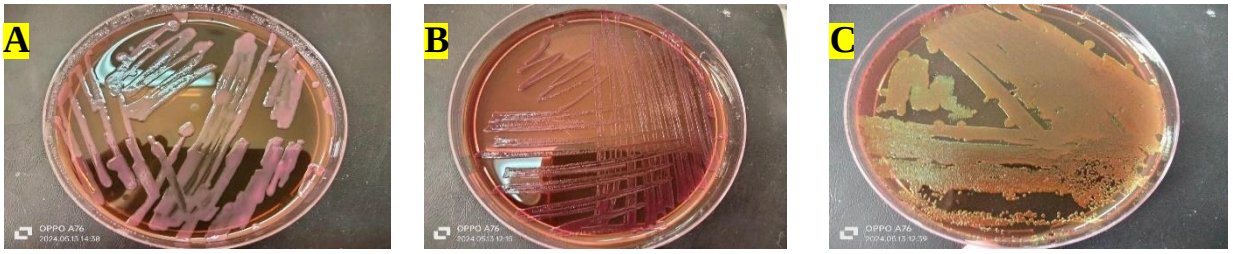

Figure 30: Colony morphology on EMBA) *Klebsiella p* ; B) *E coli*; C) *Enterobacter* (original).

The strains isolated from the fish samples (Table 3) were subjected to macro morphological phenotypic analysis. The results of this analysis showed that they are enterobacteria. They belong to the following species: *Klebsiella pneumonia*, *Enterobacter* and *Escherichia coli* with high loads almost are present in all fish organs. We have found an abundance of *Enterobacter* and *Escherichia coli* with high loads followed by *Klebsiella pneumonia* with a low load.

The presence of the genera Enterobacteriaceae and Klebsiella in foods has been reported in fish (Moshood,2012), These two groups of microorganisms have often been recognized as pathogenic for humans and are present in meat products as well as fish (Edberg, 2000).

The *E. coli* bacteria is a bacteria present in the intestine of humans and warm-blooded animals; its presence may correspond to fecal contamination (Leclerc et *al*., 2001).

Tableau 5: The results of the bacteria identified in the MSA medium.

Organ	MANNITOL SALT AGAR (MSA)						
	Coded	Appearance	Size	Color	Shape	Translucent	Strain
Fin	Nag 1	Mucosa	Small colonies	White	Round	No	*Staphylococcus aureus*
Gonad	G1	Mucosa	Average	White	Round	No	*Staphylococcus aureus*
	G2	Mucosa	Small colonies	White	Round	No	*Staphylococcus aureus*
Gill	No strain appeared						
Scale	Scale 1	Dried	Small colonies	White	Round	No	*Staphylococcus aureus*
Mouth	B1	Mucosa	Small colonies	White	Round	No	*Staphylococcus aureus*
Mouth	B2	Mucosa	Small colonies	White	Round	No	*Staphylococcus aureus*
Swim bladder	VN 1	Mucosa	Small colonies	White	Round	No	*Staphylococcus aureus*
Liver	F 1	Mucosa	Small colonies	White	Round	No	*Staphylococcus aureus*
	F2	Mucosa	Average	White	Round	No	*Staphylococcus aureus*
Anal	A1	Creamy	Small colonies	White	Round	No	*Staphylococci aureus*
Intestine	No strain appeared						
Area P	SP1	Mucosa	Small colonies	White	Round	No	*Staphylococcus aureus*
Area D	No strain appeared						
Surface G	SG1	Mucosa	Small colonies	White	Round	No	*Staphylococcus aureus*

Our results in the MSA environment, compared to those of Pillai et *al.*, (2012), the table shows the presence of the *Staphylococcus aureus* strain in fish organs in this environment. This strain has its mucous appearance in all organs, with the exception of scale 1 where it is dry, and in the anal where it is creamy. It presents a white color in all organs, forming small colonies, except in liver 2 and gonad 1 where they are of medium size. The colonies are also opaque and rounds. However, no strains were found in the gill, intestine and surface D.

Figure 91 : Colony morphology of *Staphylococcus aureus* on MSA (original).

Staphylococcus aureus, their natural reservoirs in humans, in the skin, are either halophilic and can develop in sea water. The main source of fish contamination comes from human contamination (FIAC/CITPPM, 2011), its presence in the surface of fish, this suggests contamination occurring after capture, probably due to insufficient hygiene practices during fishing or processing, but its presence in the swim bladder, liver, mouth, the anal, indicates possibilities of food poisoning because *Staphylococcus aureus* can secrete a toxin (Huss, 1988).

Tableau 6: The results of the bacteria found in the Mac Conkey medium.

Organ	**Mac CONKEY**						
	Coded	Appearance	Size	Color	Shape	Translucent	Strain
Fin	Nag1	Mucosa	Small colonies	Dark pink	Round	No	*E. coli*
	Nag2	Mucosa	Average	Beige	Round	Yes	*Proteus mirabilis*
	Nag3	Mucosa	Small colonies	Beige	Round	Yes	*Proteus mirabilis*
Gonad	G1	Creamy	Small colonies	Light beige	Round	Yes	*Proteus mirabilis*
Gill	No strain appeared						
Swim bladder	No strain appeared						
Liver	F1	Creamy	Small colonies	Beige	Round	Yes	*Proteus mirabilis*
Anal	A1	Mucosa	Small colonies	Dark pink	Round	No	*E. coli*
	A2	Mucosa	Small colonies	Pink	Round	No	*E. coli*

Intestine	IN1	Mucosa	Small colonies	Dark pink	Round	No	*E. coli*
	IN2	Mucosa	Small colonies	Dark pink	Round	No	*E. coli*
Area P	SP1	Mucosa	Small colonies	Beige	Round	Yes	*Proteus mirabilis*
	SP2	Mucosa	Small colonies	Beige	Round	Yes	*Proteus mirabilis*

In the Mac Conkey medium, we detected the presence of *E. coli* in the fins 1, the anal and the intestine, as well as the SD3 strain, which is characterized by its round shape, its mucous appearance and its pink, opaque color. In addition, the SD3 strain is mucous and forms small colonies. However, no strains were identified in the gill, swim bladder and G surface. In comparison with the results of Archana (2017)**,** we observed similar characteristics. Then the presence of *Proteus mirabilis* (Sood et *al*.,2023), creamy strains in the gonad and liver, and mucous membranes in other organs. The colonies are small, except in fins 2 where they are medium sized. They have a beige color in all organs, with the exception of the gonad where they are light beige. The colonies are round and translucent.

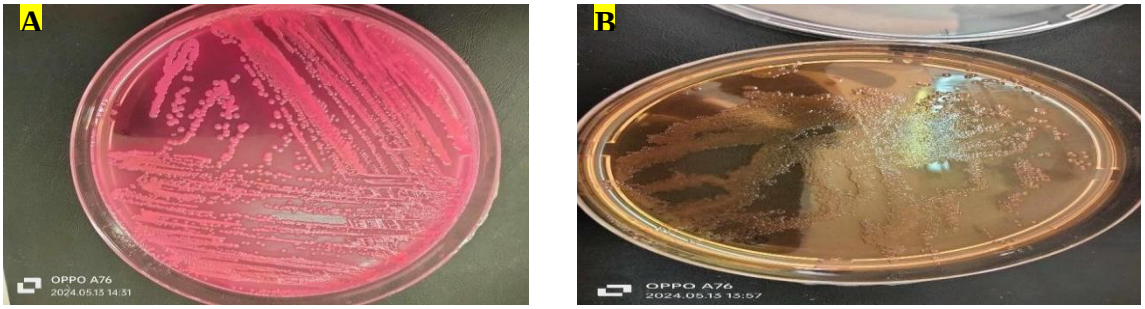

Figure 32: Colony morphology of A) *E coli;* B) *Proteus mirabilis* on Mac Conkey **(**original**).**

Species belonging to the genus *Proteus* are observed worldwide. They are part of the normal intestinal flora of humans and fish (Kim et *al.*, 2003).

The *E. coli* bacteria is a bacteria present in the intestine of humans and warm-blooded animals; its presence may correspond to fecal contamination (Leclerc et *al.*, 2001).

Tableau 7: The results of the bacteria found in the MRS medium.

Organ	MRS AGAR						
	Coded	Appearance	Size	Color	Shape	Translucent	Strain
Fins	No strain appeared						
Gonad	No strain appeared						
Gill	No strain appeared						
Scale	No strain appeared						
Mouth	No strain appeared						
Swim bladder	No strain appeared						
Liver	No strain appeared						
Anal	A1	Mucosa	Small colonies	White	Round	No	*Lactobacillus spp*
Intestine	No strain appeared						
Area P	No strain appeared						
Area D	No strain appeared						
Surface G	No strain appeared						

The results in the table indicate the absence of strains in the different fish organs in the MRS medium, with the exception of the anal where the presence of *Lactobacillus spp* was probably identified according to Taye et *al*., (2021)**,** characterized by their round shape, their small size, their opacity, their white color and their mucous appearance.

Figure 33: Colony morphology of *Lactobacillus spp* on MRS (original).

Lactobacillus a genus of the lactic acid bacteria group (Gnikpo, 2016), and although lactic acid bacteria are generally recognized as non-pathogenic germs (Leroi, 2009). Are found naturally in the digestive tract of various animals, including freshwater fish. In the case of fish, they can be present in the anal part because they help maintain the bacterial balance necessary for healthy digestion. These bacteria can help break down food and cause the growth of harmful bacteria (Gnikpo, 2016).

From these samples analyzed and the results that we found, these results are similar to those of the work Abeid et *al*. (2014). And according to the presence of pathogenic bacteria such as *E. coli*, which shows that the samples analyzed contain germs of fecal contamination, then presents an indicator of dangers or risks for the health of the consumer, we can say that the microbiological quality of TILESDIT dam fish is unsatisfactory and their consumption will not be confirmed.

Conclusion

Water is an essential element of human life, and daily human consumption of water involves monitoring from a physical, chemical and bacteriological point of view. fish are an important protein source and essential fatty acids for a balanced diet. To protect the health of consumers, it is essential to closely monitor the presence of pathogenic bacteria in fish to prevent health risks associated with contamination of contaminated fish.

The objective of this study, is to evaluate the physicochemical and bacteriological quality of raw water and the microbiological quality of fish from the Tilesdit –Bouira dam. Our results obtained in this work are as follows:

Physico-chemical analyzes revealed an almost neutral to alkaline pH (between 7.83 and 8.23), an excellent temperature (between 13.6 and 17.4°C), a conductivity which varies between 673 and 728 µs/cm, A good quality nitrate and nitrite. Poor quality ammonium.

From a bacteriological point of view, show the absence of *E. Coli* in the two months of study, and their presence in a single month with a low value, while the total coliforms expose a very clear bacterial contamination, expressed by a very high fecal contamination in the first months of study, same thing for sulfito-reducing clostridium, total germs at 37°C and 22°C in the last months of study, and the absence of fecal Streptococcus in the last month and its presence in the first two months of study but with low values.

Bacteriological pollution of water is the main cause of fish contamination and their consumption exposes the consumer to a risk of poisoning. The results of the bacteriological analysis of the fish, the majority showed that they are enterobacteria. They belong to the following species: *Klebsiella pneumonia*, *Enterobacter* and *Escherichia coli*. Followed by the presence of *Proteus mirabilis*, *Staphylococcus aureus*, *Lactobacillus spp.*

For our work, we can conclude that the raw water from Tilesdit dam is of good physico-chemical and bacteriological quality during our study period, particularly in the last month, compared to the other dams that we have cited, and the Pisces their consumption will not be confirmed.

In perspective:

- Control water quality to prevent pollution and protect aquatic ecosystems.
- The regulation of industrial and agricultural discharges.
- For wastewater treatment.

References

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Annex

Annex I: the equipment and glassware used.

Equipment	Glassware
✓ Bacteriological oven	✓50ml vial
✓ Spectrophotometer	✓Petri dish
✓ Autoclave	✓Test tube
✓ Water bath	✓Beaker
✓ Conductivity meter	✓Sterile glass bottle
✓ Micropipette	✓graduated pipettes
✓ Oximeter	✓Erlenmeyer
✓ Brick for flaming	✓Capsule
✓ The same filtration	✓Gauged specimens
✓ Turbidimeter	
✓ pH meter	
✓ The pliers	
✓ Test tube holder	
✓ The pear	
✓ Filtration discs	

Annex II: the solutions used

- **Sodium azide solution 0.5 g/l**

Carefully dissolve 0.05 g of sodium azide in approximately 90 ml of distilled water. Transfer the solution to a volumetric flask, adjust the volume to 100 ml.

- **Sodium hydroxide solution**

Carefully dissolve 20 g of sodium hydroxide in approximately 80 ml of distilled water, add 5 g of disodium salt of ethylene diamine tetraacetic acid (Na2EDTA) dihydrate, leave to cool to room temperature and transfer the solution to a volumetric flask. Adjust the volume

to 100 ml. Store this solution in a polyethylene bottle.

- **Sodium salicylate solution 10 g/l**

Dissolve 0.1 g of sodium salicylate (C7H5O3Na) in 10 ml of distilled water, prepare this solution on the day of use.

- **Colored reagent**

Dissolve 13 g of sodium salicylate (C7H6O3Na3.2H2O) and 13 g of trisodium citrate dihydrate (C6H5O7Na3.2H2O) in ammonium-free water contained in a 100 ml volumetric flask, add 0.097 g of sodium nitrosopentacyanoferrate (III) dihydrate Na2{Fe(CN) 5NO}2H2O, complete the volume to 100ml. Store this reagent in a brown glass bottle; it is stable for at least two weeks.

- **Sodium dichloroisocyanurate solution**

Dissolve 3.2 g of sodium hydroxide (NaOH) in 50 ml of ammonium-free water, cool the solution to room temperature and add 0.2 g of dichloroisocyanuratedihydrate (C3N3O3Cl2Na.2H2O) dissolve the solid and make up the volume to 100 ml.

Store this reagent in a brown glass bottle; it is stable for at least two weeks.

- **Washing solution**

Dissolve 25 g of potassium hydroxide in 25 ml of ammonium-free water, cool the solution and add 225 ml of 95% pure ethanol. Store this solution in a polyethylene bottle.

Annex III: the composition of the media used

- **TGEA**

- Casein peptone 5ml
- Meat extract 3ml Yeast
- extract 1ml Glucose
- 1ml Agar 18ml
- Agar

  20ml

- **Rothe broth**

- Polypeptone 20.0 g
- Sodium chloride 5.0 g
- Glucose 5.0 g
- Dipotassium phosphate2.7 g

  Monopotassiumphosphate2.7g

- Sodium azide 0.2 g

EVA Litsky

- Polypeptone20, 0 g
- Glucose5.0 g
- Sodium chloride 5.0 g
- Monopotassium phosphate 2.7 g Dipotassium phosphate 2.7 g
- Sodium azide 0.3 g
- Ethyl-violet 0.5 mg

BCPL broth

- Peptone 5.0g
- Beef extract 3.0g Lactose 10.0g
- Bromocresol purple 25ml agar 15g

Broth Luria Bertani (LB)

- Tryptone 10g
- Yeast extract 5g
- Soduim chloride 10g

Mac Conkey Agar

- Pancreatic gelatin peptone 17g
- Pancreatic Casein Peptone 1.5g
- Pancreatic meat peptone 1.5g
- Lactose 10g
- Sodium chloride 5g Bile salts 1.5g
- Neutral red 30mg Gentian violet 1mg Agar 13.5g
- 50g Mac Conkey Agar powder in 1 liter of distilled water.

MRS Agar

- Peptone 10.0g
- Meat extract 10.0g
- Yeast extract 5.0g
- Glucose 20.0g
- Sodium acetate 5.0g
- Manganese sulfate 0.05g
  Disodium phosphate 2.0
  g Magnesium sulfate 0.1
  g Polysorbate 1g
- Agar 15g
- 68.3g MRS Agar powder in 1 liter of distilled water.

Appendix VI: Mac Grady MPN table (most probable number)

NOMBRE LE PLUS PROBABLE ET INTERVAL DE CONFIANCE DANS LE CAS DU SYSTEME D'ENSEMENCEMENT N°2

Nombre de tubes donnant une réaction positive sur			N.P.P dans 100 ml	Limite de confiance à 95 %	
5 tubes de 10 ml	5 tubes de 1 ml	5 tubes de 0,1 ml		Limite inférieure	Limite supérieure
0	0	1	2	< 0,5	7
0	0	0	2	< 0,5	7
0	1	0	4	< 0,5	11
1	1	0	2	< 0,5	1
1	2	1	4	< 0,5	11
1	3	0	4	< 0,5	11
1	0	1	6	< 0,5	15
1	0	0	6	<0,5	15
2	1	0	5	< 0,5	13
2	1	1	7	1	17
2	2	0	7	1	17
2	2	1	9	2	21
2	3	0	9	2	21
2	0	0	12	3	28
3	0	0	8	1	19
3	1	1	11	2	25
3	1	0	11	2	25
3	1	1	14	4	34
3	2	0	14	4	34
3	2	1	17	5	46
3	3	0	17	5	46
4	0	0	13	3	31
4	0	1	17	5	46
4	1	0	17	5	46
4	1	1	21	7	63
4	1	2	26	9	78
4	2	0	22	7	67
4	2	1	26	9	78
4	3	0	27	9	80
4	3	1	33	11	93
4	4	0	34	12	96
5	0	0	23	7	70
5	0	1	31	11	89
5	0	2	43	15	114
5	1	0	33	11	93
5	1	1	46	16	120
5	1	2	63	21	154
5	2	0	49	17	126
5	2	1	70	23	168
5	2	2	94	28	219
5	3	0	79	25	187
5	3	1	109	31	253
5	3	2	141	37	343
5	3	3	175	44	503
5	4	0	130	35	302
5	4	1	172	43	486
5	4	2	221	57	698
5	4	3	278	90	849
5	4	4	345	117	999
5	5	0	240	66	754
5	5	1	348	118	1 005
5	5	2	542	180	1 405
5	5	3	918	303	3 222
5	5	4	1 609	635	5 805

NOMBRE LE PLUS PROBABLE ET INTERVAL DE CONFIANCE DANS LE CAS DU SYSTEME D'ENSEMENCEMENT N°1

Nombre de tubes donnant une réaction positive sur			N.P.P dans 100 ml	Limite de confiance à 95 %	
3 tubes de 10 ml	3 tubes de 1 ml	3 tubes de 0,1 ml		Limite inférieure	Limite supérieure
0	0	1	3	< 0,5	9
0	1	0	3	< 0,5	13
1	0	0	4	< 0,5	20
1	0	1	7	1	21
1	1	0	7	1	23
1	1	1	11	3	36
1	2	0	11	3	36
2	0	0	9	1	36
2	0	1	14	3	37
2	1	0	15	3	44
2	1	1	20	7	89
2	2	0	21	4	47
2	2	1	28	10	149
3	0	0	23	4	120
3	0	1	39	7	130
3	0	2	64	15	379
3	1	0	43	7	210
3	1	1	75	14	230
3	1	2	120	30	380
3	2	0	93	15	380
3	2	1	150	30	440
3	2	2	210	35	470
3	3	0	240	36	1 300
3	3	1	460	71	2 400
3	3	2	1 100	150	4 800

Annex VI: the figures of the positive results of bacteria

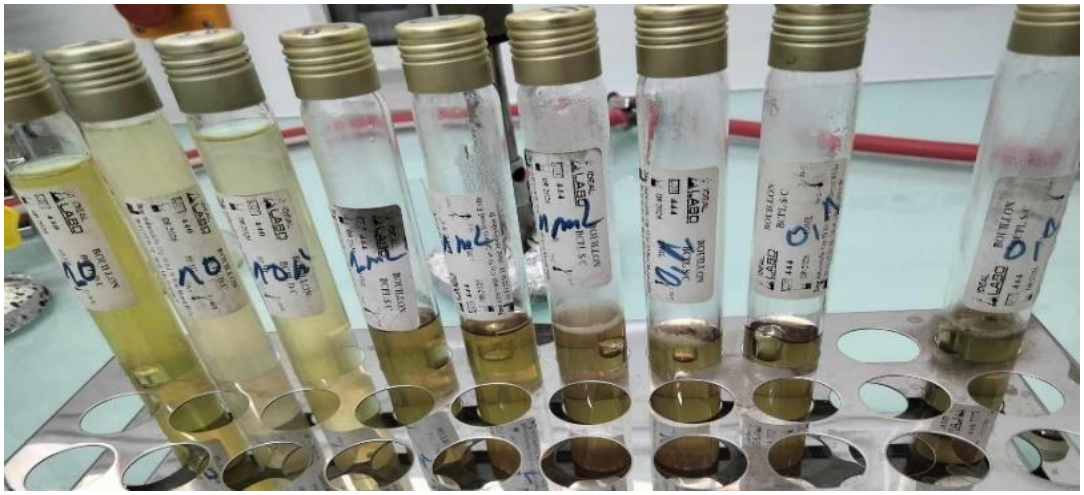

Figure: Total coliform positive tube results.

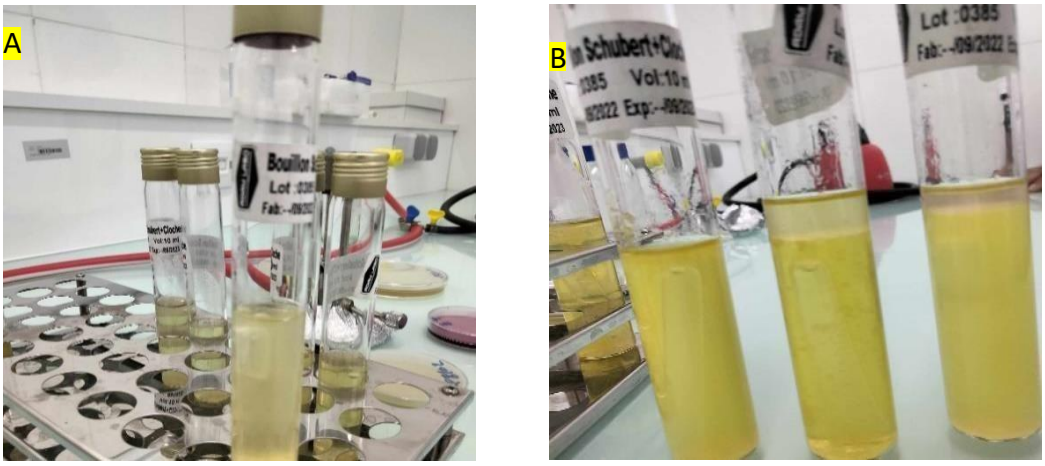

Figure: A) CF positive tubes; B) Absence of *E. coli* in February.

Abstract

Abstract

The TILESDIT Bouira dam, considered one of the most important rivers in Algeria. And to monitor the current state of the fish and to assess the quality of the water flowing in this dam, water samples were taken from this dam over a period of February, March and April 2024. This study concerns physicochemical analyzes (Temperature, pH, conductivity, turbidity, salinity, TDS, dissolved oxygen, nitrate, nitrite, ammonium) and the evaluation of bacterial contamination (total coliforms, fecal, *E coli*, fecal *streptococcus*, ASR), total germs. And the evaluation of bacterial contamination of fish. The results from the physicochemical analyzes show that the neutral alkaline pH, the temperature of this watercourse is normal, a fair quality of conductivity, a poor quality of dissolved oxygen. Slightly cloudy in turbidity, nitrates and nitrites are of good quality, except ammonium is of poor quality. As well as the search for bacterial contamination, the results that we recorded show bacterial contamination in the first two months of study (February, March), absence in the last month (April), and the opposite for the total germs. On the other hand, results of the bacteriological analysis of fish, the majority showed that they are enterobacteria. They belong to the following species: *Klebsiella pneumonia, Enterobacter* and *Escherichia coli*. Followed by the presence of *Proteus mirabilis, Staphylococcus aureus, Lactobacillus spp*.

Keywords: TILESDIT dam, fish, water, physicochemical analysis, bacteriological analysis.

Résumé

Le barrage TILESDIT Bouira, considéré comme l'une des cours d'eaux les plus importants en Algérie. Et pour surveiller l'état actuelle des poissons et pour évaluer la qualité des eaux qui coule dans ce barrage, on été effectués des prélèvements d'eaux au niveau de ce barrage sur une période du mois d'février, Mars et Avril 2024. Cette étude concerne les analyses physico- chimiques (Température, pH, conductivité, turbidité, salinité, TDS, oxygène dissous, nitrate, nitrite, ammonium) et l'évaluation de contamination bactérienne (les coliformes totaux, fécaux, *E coli*, les streptocoques fécaux, ASR), les germes totaux. Et l'évaluation de contamination bactérienne de poisson. Les résultats issus des analyses physicochimiques montrent que le pH neutre alcalin, la température de ce cours d'eau est normale, une qualité passable de la conductivité, une mauvaise qualité d'oxygène dissous. Légèrement trouble de la turbidité, les nitrates et les nitrites d'une bonne qualités, sauf l'ammonium présente une mauvaise qualité. Ainsi que la recherche de contamination bactérienne, les résultats qu'on a enregistrés montrent une contamination bactérienne dans les deux premiers mois d'étude (Février, Mars), l'absence dans le dernier mois (Avril), et l'inverse pour les germes totaux. D'autre part, résultats de l'analyse bactériologies des poissons, la majorité ont montré qu'elles sont des entérobactéries. Elles appartiennent aux espèces suivantes : *Klebsiella pneumonie, Enterobacter* et *Escherichia coli.* Suivi par la présence de *Proteus mirabilis, Staphylocoques aureus, Lactobacillus spp.*

Mots clés : Barrage TILESDIT, poisson, l'eau, analyse physico-chimique, analyse bactériologique.

ملخص

يعتبر سد تيلسديت بويرة من أهم الأنهار في الجزائر. ولمراقبة الوضع الحالي للأسماك وتقييم جودة المياه المتدفقة في هذا السد، تم أخذ عينات من المياه في هذا السد خلال فترة فبراير ومارس وأبريل 2024. تتعلق هذه الدراسة بالتحاليل الفيزيائية والكيميائية)درجة الحرارة، ودرجة الحموضة، والتوصيل، والتعكر، والملوحة، والمواد الصلبة الذائبة، والأكسجين المذاب ، والنترات ، والنتريت ، والأمونيوم(وتقييم التلوث البكتيري)القولونيات الكلية ، البراز ، الشريكة القولونية ، المكورات العقدية البرازية ، العصر(، الجراثيم الكلية. وتقييم التلوث الجرثومي للأسماك. تظهر نتائج التحاليل الفيزيائية الكيميائية أن درجة الحموضة القلوية محايدة، ودرجة حرارة هذا المجرى المائي طبيعية، ونوعية عادلة للموصلية، ونوعية رديئة للأكسجين المذاب. عكر قليل، النترات والنتريت من نوعية جيدة، باستثناء اللأمونيوم لديه نوعية بالإضافة إلى البحث عن التلوث البكتيري، تظهر النتائج المسجلة تلوثا بكتيريا في الشهرين الأولين من الدراسة) فبراير ،رديئة ، مارس(، والغياب في الشهر الماضي)أبريل (، والعكس صحيح بالنسبة للجراثيم الكلية. من ناحية أخرى، فإن نتائج التحليل البكتريولوجي للأسماك، أظهرت الغالبية أنها بكتيريا معوية. وهي تنتمي إلى الأنواع التالية: الالتهاب الرئوي كليبسيال، المعوية والشريكة القولونية. تليهاوجود بروتيوس ميرابيليس، المكورات العنقودية الذهبية، الملبنة النياب

الكلمات المفتاحية: سد تيلسديت، الأسماك، الماء، التحليل الفيزيائي الكيميائي، التحليل البكتريولوجي