“A FORMULATION OF MICROBIAL MEDIA USING BANANA PEEL WASTE”

A RESEARCH PROJECT

Submitted by

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UNDER THE GUIDANCE OF

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DEPARTMENT OF MICROBIOLOGY

VIVEKANAND COLLEGE, KOLHAPUR

(AN EMPOWERED AUTONOMOUS INSTITUTE)

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"Dissemination of education for Knowledge, Science and culture"

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Shri Swami Vivekanand Shikshan Sanstha`s

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OF

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This is to certify that **Ms. HARSHADA B. BODAKE** studying in M. Sc. part II Microbiology at Vivekanand College, Kolhapur (Empowered Autonomous) has sincerely completed research project work entitled **"A FORMULATION OF MICROBIAL MEDIA USING BANANA PEEL WASTE."** during academic year 2024-25.

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Research Project Guide

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Place: Kolhapur

Date: 18/12/2024

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INTRODUCTION

Introduction:

Waste management is important because it helps protect the environment, human health and the economy. Banana peel can take up to two years to decompose. According to the world health department world produce 2.12 billion tons of waste per year. It refers to the systematic process of collecting, treating, and disposing of waste materials to minimize their impact on human health, the environment, and the economy. It encompasses a range of activities, from waste generation and segregation to recycling, reuse, and final disposal. Effective waste management is essential for maintaining a clean and sustainable environment, especially in the face of increasing global waste production.

Bananas are one of the most widely consumed fruit in the world. The food processing industry discarded a huge amount of banana peel while manufacturing chips, flour, juice, jam, baby food and other products made from bananas. About 57.5 million tons of bananas waste were produced by India annually. In Maharashtra 4.5 million tons of waste produced annually.

Banana peel waste contributes to environmental issues like climate change, greenhouse gas emissions and can create odor. The scientific name for the banana is ***Musa paradisiaca***.

Table 1: Scientific classification of Banana.

Kingdom	*Plantae*
Division	*Magnoliophyta*
Class	*Liliopsida*
Order	*Zingiberales*
Family	*Musaceae*
Genus	*Musa*
Species	*acuminata*

Banana peels can be used as a source of nutrients and bioactive compounds. The mineral composition of banana peel was phosphorus, irons, calcium, magnesium, and sodium. The cell of banana peel is made up of cellulose, hemicellulose and pectin. They Also contain crude proteins and carbohydrates. They can also use to produce oligosaccharides.The pH of banana peels is around 9.91 which is Basic but it decreases to about 6.39 when dehydrated. Banana peels are organic waste that are highly reach in carbohydrate contain and other basic nutrients that support microbial growth. Banana peels can help neutralize soil acidity. In high concentration, they can even change the pH of soil. *(Hassan, M. M., et al. (2019)*

Banana peel has good potential to be used as sources of antioxidants in food *(Ode Ermawati, 2016).* Banana peel have a bioactive component, particularly the phenolic compounds.

Through research, experimentation, and community engagement, this project highlights the potential of converting agricultural waste into useful resources, fostering a greener and more sustainable future. Improper disposal of banana peels, such as dumping in landfills, contributes to environmental challenges, including methane emissions during decomposition and inefficient waste management practices. However, banana peels can be repurposed for various uses. Utilizing banana peel waste not only reduces environmental pollution but also contributes to a circular economy by transforming waste into valuable resources. This aligns with global efforts to promote sustainability and minimize the environmental impact of organic waste. *(Ragab, G. H., & Ghanem, K. M. 2021).*

- Banana peel for oil spill removal:

It was found that surface properties oil type, oil fill thickness sorption time, temperature, as well as salinity, all effect oil sorption capacity. The above experiments results shows that the best condition, it was at average practical size of 0.3625 mm 25 degree Celsius for 15 minutes, sorption time 3.5% artificial sea water finally 5mm.

Oil fill thickness, this condition gives maximum value of sorption capacity for gas oil one day and 7-day crude oil. The sorption can be more than 10-time research 50% of first sorption value.

Over all, it can be seeing that sorption capacity of banana peel gives a good result as a new and low-cost agriculture, waste oil for spill subsequently banana peel not only peels help in lowering of environmental contamination. But also help in the reduction of agriculture waste.

Fruit waste banana peel, and logan waste, where stabilized using anerobic, digestion where biogas and digested, digestion can be utilized, physical pretreatment, size reduction increased biodegradability methane yield/ rate of banana peel in batch fermentation.

The pre-hydrolysis thermophilic react as biological pre-treatment helped stabilized. The digestion process in insuring mesophilic, particularly at high solid, feed stock, the overall destruction biogas production. *(. Research by Sulaiman et al. 2011)*

- Significance:

The finding of this study highlights the significance of banana peel waste as a rich source of microorganisms with potential application in biotechnology, agricultural and environmental remediation. This study demonstrates the important of exploring alternative waste management strategies that utilize microorganisms to convert organic waste materials into valuable resources.

The results of this study underscore the significance of microbiology research in addressing the environmental and economy challenges associated with organic waste management.

- Implications:

The implications of this study are for – reaching, suggesting that banana peel waste can be converted into valuable resource such as bioremediation agents, reducing waste disposal costs and promoting sustainable developments. This study has significant implication for development of sustainable waste management practices highlighting and potential for microorganisms to play a key role in the degradation of organic waste materials. *(Ragab, G. H., & Ghanem, K. M. 2021)*

The finding of this study imply that banana peel waste can be used as a nutrient – rich substrates for microbial growth providing a cost – effective and environmentally friendly solutions

for waste management and resource recovery. Banana peel waste has several implications, both positive and negative, depending on how it is managed. Here are some key points:

- Negative Implications:

1. Environmental Pollution: When discarded improperly, banana peels can contribute to landfill waste. They decompose anaerobically in landfills, releasing methane, a potent greenhouse gas.

2. Waste Management: The large volume of banana peels generated worldwide from banana consumption can overwhelm waste management systems, especially in urban areas.

3. Pest Attraction: If left exposed in public spaces or improperly disposed of, banana peels can attract pests, such as rats and insects.

Positive Implications:

4. Agricultural Benefits: Banana peels are rich in nutrients like potassium, phosphorus, and calcium, which can be used as natural fertilizers. They can be composted or used directly in gardens to improve soil quality.

5. Sustainable Alternatives: Banana peels have been explored as a source of bioplastics and other sustainable materials. Research is ongoing to convert them into valuable products such as biodegradable films.

6. Health and Nutrition: In some cultures, banana peels are used in cooking, beverages, or as a natural remedy for various health issues, due to their antioxidant and anti-inflammatory properties.

Overall, while banana peel waste can pose environmental challenges, it also holds potential for sustainable practices if properly managed and utilized.

- Banana Peel Media Theory:

1. Banana peel media is a nutrient-rich medium that supports the growth of various microorganisms due to its high content of carbohydrates, proteins, and fibers.

1. The pH of banana peel media, ranging from 5.5 to 6.5, creates an acidic environment that favors the growth of fungi and yeast.

2. Banana peel media contains various phytochemicals, such as phenolics and flavonoids, which exhibit antimicrobial and antioxidant properties.

3. The high water content and porous structure of banana peel media facilitate the growth of microorganisms by providing a suitable environment for gas exchange and nutrient uptake.

4. Banana peel media can be enriched with additional nutrients, such as nitrogen and phosphorus sources, to enhance microbial growth and productivity.

- Microbial Growth Theory:

1. Microorganisms grow on banana peel media by utilizing the available nutrients, such as carbohydrates, proteins, and fibers.

2. The growth of microorganisms on banana peel media is influenced by factors such as pH, temperature, and moisture content.

3. Banana peel media supports the growth of various microorganisms, including bacteria, yeast, and fungi, due to its nutrient-rich composition.

- Effect of Banana peel waste on Environment:

1. Reduction of Organic Waste: Banana peel agar helps reduce the amount of banana peel waste that would otherwise end up in landfills. By repurposing this organic waste, it lessens the environmental burden of waste disposal, contributing to waste minimization.

2. Sustainability: Banana peels are a renewable resource, and their use to create agar reduces the reliance on non-renewable resources, such as red algae, which is typically used for commercial agar production. This substitution can help conserve marine ecosystems and reduce the impact of overharvesting of algae species.

3. Lower Carbon Footprint: The process of extracting agar from banana peels is generally more energy-efficient compared to traditional agar production. Since banana peel is an agricultural

byproduct, using it reduces the need for extensive processing and transportation associated with harvesting marine algae, contributing to a lower carbon footprint.

4. Improved Soil Health: Banana peel agar, when used as a biopolymer or in agriculture, can enhance soil health and fertility. The rich nutrients in banana peels, such as potassium, phosphorus, and magnesium, contribute to better soil quality when they are used in compost or as a component in sustainable farming practices.

5. Reduction in Plastic Use: Since banana peel agar can be used as a biodegradable alternative to plastic in certain applications (like food packaging or biomedical uses), it offers an environmentally friendly option to replace petroleum-based plastics. This could help reduce plastic pollution in landfills and oceans.

6. Promotion of Circular Economy: The use of banana peel agar aligns with the principles of the circular economy, where waste products are transformed into valuable resources. This encourages the reuse of agricultural waste and helps create sustainable solutions, reducing environmental degradation.

7. Potential for Biodiversity Preservation: By reducing the need for harvesting red algae, the use of banana peel agar can contribute to the preservation of marine biodiversity, as overharvesting of algae can disrupt marine ecosystems and affect species that depend on algae for food and habitat.

In conclusion, banana peel agar presents a promising eco-friendly alternative to traditional agar, offering several environmental benefits by reducing waste, conserving resources, and lowering environmental impacts. *(Senthilkumar, P., et al. 2020).*

Formulating banana peel waste into useful products or solutions can help address pollution by reducing organic waste disposal, mitigating greenhouse gas emissions, and creating eco-friendly alternatives to harmful materials.

REVIEW OF LITERATURE

Review of literature:

Bananas are the most abundant agricultural product compared to other fruits in Asia. Bananas are widely cultivated both as commercial and household commodities. The nutritional content of Banana peels quite complete carbohydrates, fats, protein, calcium, phosphate, iron, vitamin B, vitamin C and water. Peels contains activity antioxidants are quite high compared to meat. The antioxidant activity of banana peels reaches 94.25%. concentration of 125mg/ml while in the fruit it is only approx. 70% at a concentration of 50mg/ml. Antioxidant compounds found in banana peels namely catechins, Gallo catechins and epicatechins which are class of flavonoid compounds. Banana peels have good potential to be used as sources of antioxidants in food.

Banana peel waste generated from household consumption, food processing industries, agricultural industries, markets and retail stores. The environmental impacts of banana peels contribute to greenhouse gas emission, can attract rodents and flies, pollutes water waste through improper disposal, occupies landfill space. *(Mohapatra et al.2010).*

The biotechnological applications of banana peels are used as substrate for microbial growth, leading to the production of valuable biotechnological products. For example, Enzymes such as celluloses and amylase have been produced using banana peels which are used in various industries including food and textile. *(Research by Sulaiman et al.2011)*.

Banana peel have high significant potential in biotechnology due to its rich organic composition. In Bioethanol production banana peels and other waste contains high levels of carbohydrates like cellulose, hemicellulose and simple sugars, making them excellent substrates for fermentation. Through microbial processing, banana waste can be converted into bioethanol, a renewable energy source*. [Nisha et al. (2012)]*

In production of value-added products like in enzymes, certain fungi and bacteria can be cultured on banana waste to produce industrially relevant enzymes like amylases and cellulases. In Bioplastics, banana peels and *Pseudostems* can be used as raw materials for creating biodegradable plastics. Their high cellulose content is valuable for producing eco-friendly packaging and other biopolymer products.

In pharmaceuticals, banana waste contains bioactive compounds like phenolics, antioxidants and vitamins which can be extracted and used in the development of pharmaceuticals properties.

In animal feed, dried and processed banana waste can be used as a cost-effective feed supplement for livestock due to its nutrient content, particularly fibers and carbohydrates.

In water purification, Banana peels have been shown to have adsorbent properties and can be used in biotechnological applications to remove heavy metals and pollutants from wastewater.

Banana waste in plant tissue refers to the leftover parts of the banana plant that are not used for food or other commercial purposes. These include discarded parts like banana peels, pseudomonas (the trunk-like structure), and leaves. Banana waste is generated during the harvesting, processing, and consumption of bananas. *[University of California. (2020)]*

TYPES OF BANANA WASTE:

The skin of the banana, often discarded after consumption but ban can be used for various purpose like animal feed, biogas production, or as a source of bioactive compounds.

In banana's white leaves, while used for wrapping food in some cultures, after often discarded in commercial farming. In damaged banana's they are don't make it to market or are unsuitable for sale but may still have useful properties.

USES AND POTENTIAL BENEFITS OF BANANA WASTE:

In Animal feed banana peels are rich in nutrients and can be used as livestock feed after proper processing. In nutritional and medicinal use, the banana peels contain antioxidants, vitamins, and minerals, and they have been studied for their potential in their potential in food supplements or as part of herbal medicine.

ENVIRONMENTAL IMPACT:

Banana waste, when not utilized, contributes to environmental pollution, particularly in banana-producing regions. However, its recycling or upcycling into valuable products can reduce waste and provides economic opportunities in banana-growing communities.

WASTE ACCUMULATION: Banana peel contribute to organic waste in landfills, where they decompose anaerobically, realizing methane- a potent green house.

SHORT DECOMPOSITION PERIOD: Compared to plastics, banana peel decomposes quickly, making them a less harmful waste product.

BIOPLASTICS: Banana peels can be processed into biodegradable plastics, reducing dependency on petroleum-based product.

PAPER AND PACKAGING: The fibers from banana peel can be used to make ecofriendly paper or packaging materials.

MEDICAL APPLICATIONS: They may aid in treating certain skin conditions and as base for bioactive compounds in pharmaceuticals.

SKIN TREAETMENT: Banana peel extract have antioxidant and antimicrobial properties, making them useful in skin care product.

- Applications Theory

1. Banana peel media can be used as a cost-effective and sustainable alternative to traditional media for microbial cultivation.

2. The use of banana peel media can reduce the environmental impact of microbial cultivation by minimizing waste generation and promoting the use of renewable resources.

3. Banana peel media has potential applications in various fields, including biotechnology, agriculture, and environmental science. Using banana peel agar, which is typically derived from the waste material of banana peels, can have several positive effects on the environment, especially when compared to traditional agar derived from red algae.

4. Organic Fertilizer

Composting: Banana peels are rich in potassium, phosphorus, and other essential nutrients, making them an excellent ingredient in organic compost. This reduces the need for chemical fertilizers that contribute to soil and water pollution.

5. Animal Feed

Processed banana peels can be used as an ingredient in animal feed, reducing the demand for commercial feed production, which often contributes to deforestation and water pollution.

6. Cosmetic and Pharmaceutical Applications

Skincare Products: Banana peels contain antioxidants and anti-inflammatory properties, which can be used in eco-friendly cosmetics.

Medicinal Uses: Banana peel extracts can be formulated into products for antimicrobial or wound-healing applications

7. Paper Production:

Banana peels can be processed into pulp to make biodegradable paper, reducing the need for tree-based paper and the environmental damage associated with deforestation.

MATERIALS AND METHODS:

Methodology:

The Methodology of utilizing banana peel waste depend upon the specific applications or purpose such as composting, biofuel production, water purification or creating biodegradable materials. Below is a general outline that can adapted based on the intended use:

1. **Collection of Banana peels –**
    - we gathered banana peels from households, markets or food industries.
    - Separated the peels from other waste materials to ensure purity.

2. **Preparation of banana peels-**
    - **Cleaning:** Washed the peels to remove dirt, pesticides or contaminants.
    - **Grinding:** For certain applications peels can be grounded into paste.

3. **Boiling and filtration:**
    - **Boiling:** to reduce microbial contamination, soften fibers and facilitates further processing.

    (Boiling the paste in the water for 10 to 15 minutes.)
    - **Filtration:** Then we separated the solid residue form liquid extract for the filtration. we used a filtration medium (Filter paper or Sand paper). Then we separated the treated water from the adsorbent.
    - **media preparation:** we used banana peel filtrate/ waste refers to creating nutrient- rich growth medium for cultivation of micro-organism.

4. **Sterilization and soil dilution:**
    - **Sterilization**: To remove contaminants, ensure purity, improve safety, enhance stability sterilization has done by autoclaving method of sterilization.
    - **Soil dilution:** Soil collected from place of waste discarded area. Used well-drained soil with a neutral pH (6.0 – 7.5 is ideal for most bacteria).
    - Remove debris, stones, or large clumps for even mixing.
    - **Dilution ratios:** The organic material-to-soil ratio generally ranges from 1:4 to 1:10 (1 part of organic matter to 4 to10 part of soil).

5. **Pouring and spreading:**
    - **Agar pouring**: Agar pouring is the process of preparing and pouring agar-based media into Petri dishes to culture micro-organisms.
    - **Spreading**: This method ensures even distributers of diluted soil suspensions on agar plates to promote the growth of distinct microbial colonies for analysis.

6. **Incubation and count colonies:**
    - **Incubation:** To provide optimal conditions for microbial growth so colonies can form from individuals' micro-organisms.
    - Incubate plates upside down (agar side up) to prevent condensation from dripping onto the colonies at 37 degree C for 24 to 48 hours.
    - **Colony counts**: To estimate the microbial population in the original soil sample based on colony forming units (CFUs).

7. **Gram staining and motility:**

    These are fundamental microbiological techniques used to classify and study organisms based on their cell wall structure and ability to move, respectively.

Media preparation and procedure:

1. **Material Needed:**
    - Fresh banana peels (Banana peel paste),
    - Soil (soil dilution)
    - pH strips
    - Agar-agar powder
    - Distilled water, glass funnel, glass rod, micropipettes.
    - Grinder
    - Measuring tools (Beakers, weighing scale, cylinders)
    - Sterile containers: (Petri plates, flasks, Test tubes, Sterile tips).
    - Filter paper.

For 10% concentration:

Preparation:

We have used 10 grams of fresh Banana peel paste per 100 ml of distilled water to make 10% concentration.

Procedure:

We boiled the above the mixture for 10 to 15 minutes and filtrate the mixture using funnel and filtrate paper. Then cool down the filtrate and add 2.5 gm Agar-Agar powder in it. Then we mixed well using glass rod and then autoclave it. Then sterilize media by autoclaving at 121 degree C for 15-20 minutes at 15 psi pressure.

After sterilization we prepared the plates and allowed them solidified the media. Took the 100 uL of soil diluted suspension of different concentration (10^{-2} to 10^{-6}) and spreader on different

plates respectively (labelled). Then incubates the plates upside down at 37 degree C for 24 to 48 hours.

Staining:

After incubation well isolated colonies are observed and take one of the colonies and made a suspension to perform Gram staining and motility.

Gram Staining:

- **Procedure**:

- A heat-fixed smear of the bacterial sample was prepared on a microscope slide.
- The smear was flooded with crystal violet stain and left for about 1 minute.
- The slide was gently rinsed with water to remove excess stain.
- Gram's iodine solution was added to the smear and allowed to sit for 1 minute to act as a mordant.
- The slide was rinsed again with water.
- The smear was decolorized by adding ethanol or acetone for a few seconds until the purple color washed away (in Gram-negative cells), and then it was immediately rinsed with water to stop the decolorization process.
- Safranin, a counterstain, was applied to the smear and left for 1 minute.
- The slide was rinsed one last time with water and gently blotted dry using bibulous paper.

For 20% concentration:

Preparation:

Used 20 grams of fresh Banana peel paste per 100 ml of distilled water to make 20% concentration.

Staining:

After incubation well isolated colonies are observed and take one of the colonies and made a suspension to perform Gram staining and motility.

For 40% concentration:

Preparation:

Used 40 grams of fresh Banana peel paste per 100 ml of distilled water to make 40% concentration.

Staining:

After incubation well isolated colonies are observed and take one of the colonies and made a suspension to perform Gram staining and motility.

For 60% concentration:

Preparation:

Used 60 grams of fresh Banana peel paste per 100 ml of distilled water to make 60% concentration.

Staining:

After incubation well isolated colonies are observed and take one of the colonies and made a suspension to perform Gram staining and motility.

For 80% concentration:

Preparation:

Used 80 grams of fresh Banana peel paste per 100 ml of distilled water to make 80% concentration.

Staining:

After incubation well isolated colonies are observed and pickup one of the colonies and made a suspension to perform Gram staining and motility.

For 100% concentration:

Preparation:

Used 100 grams of fresh Banana peel paste per 100 ml of distilled water to make 100% concentration.

Staining:

After incubation well isolated colonies are observed and take one of the colonies and made a suspension to perform Gram staining and motility.

RESULT

Results:

- **Collection of Soil:**

Collected small samples from various points within the contaminated are and mixed them to get a sample. Soil is collected from the industrial sites and waste areas. Kept that soil samples in cool, dark place during the project.

Figure no 1: collection of soil from waste discarded area.

Made a serial dilution of soil to estimate the population of microorganisms present in soil sample.

Figure no 2: Soil Dilution

- **Collection of Banana peels:**

Banana peels are collected from the household, chip industries and markets. Collected banana peel grinded to make a paste.

Places:

I. HOT CHIPS, Shop No.5, E Ward, Tarabai Park, Kolhapur, Maharashtra 416001.

II. Chavanwadi, Borgaon Panhala, Kotoli 416230.

III. Shahu Market Yard, Kolhapur, Maharashtra 416005.

Fig no:3 **(Collected Banana) (Collected banana peels) (Banana peel paste)**

We weigh the banana peel paste and boil it to get the filtrate according to concentration.

Fig no:4 Boiling the waste filtrate after filtration

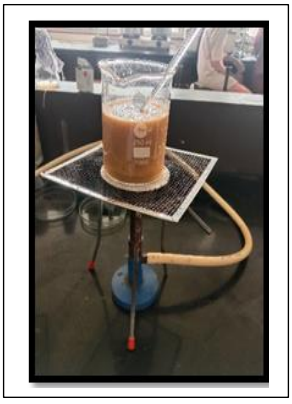
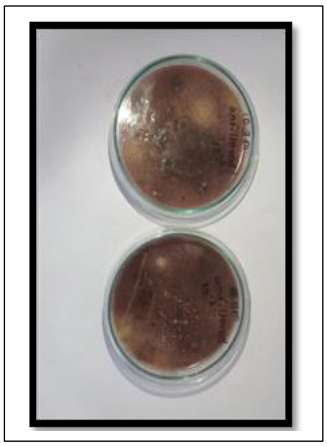


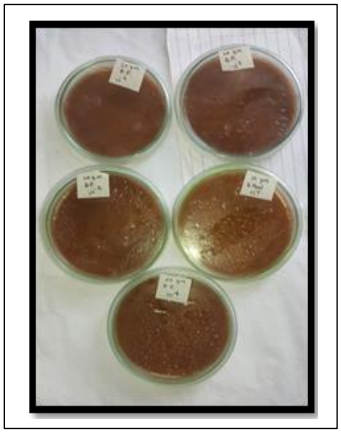
Fig no:5	*(filtrate after boiling)*	*(waste media plates)*	*(filtrate plates)*



For 10% concentration:

After incubation we got the well isolated colonies, performed the Gram staining and motility. To preserve the colonies gave them transfer on the slant using same concentrated media.

Fig no:6	*(10% conc. plates)*	*(10% conc. Slants)*



Gram staining :

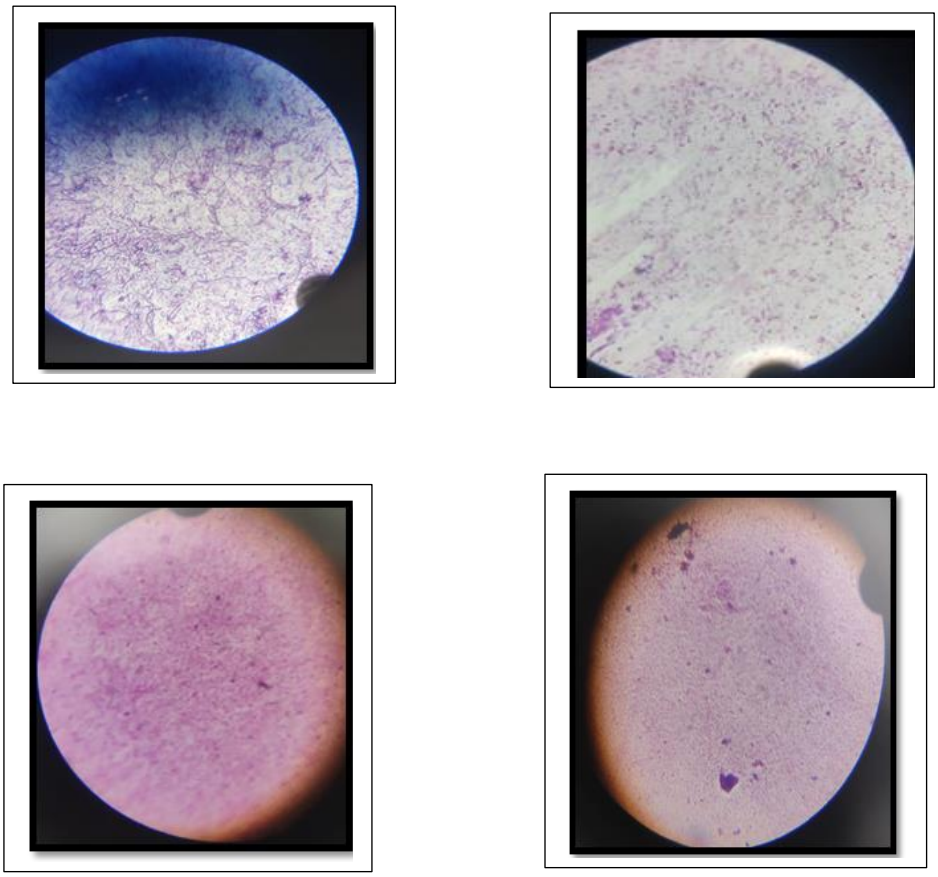


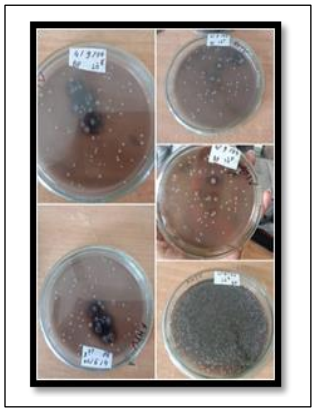
Table 2: Gram Nature of organisms isolated on 10 % conc. media plates.

Sr. No	Concentration	Gram nature	Shape
1	**10^{-2}** Conc	Gram Positive	**Rod** (in chain)
2	**10^{-3}** Conc	Gram Positive	**Short rod**
3	**10^{-4}** Conc	Gram Positive	**Short rod**
4	**10^{-5}** Conc	Gram Positive	**Cocci**

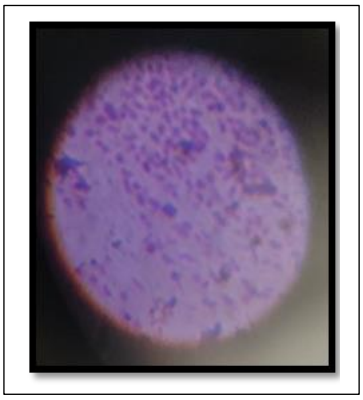
For 20% concentration:

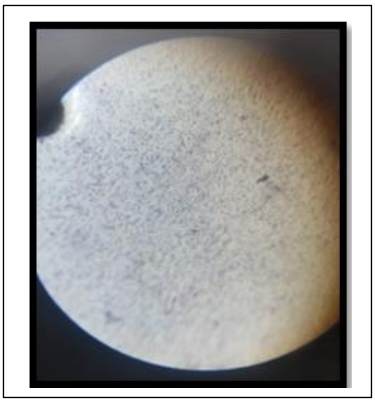
FILRATRATE:

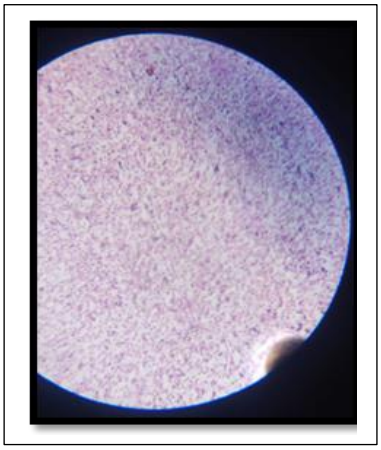
Fig no:7 (20% conc. Filtrate plates) (20% conc. Slant)



Gram Staining:







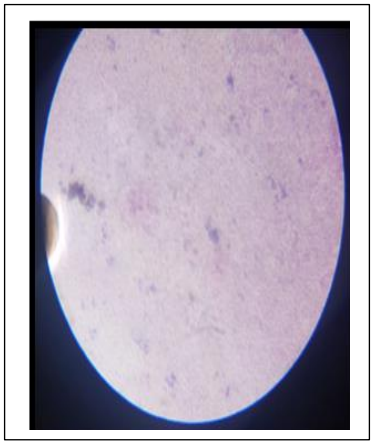
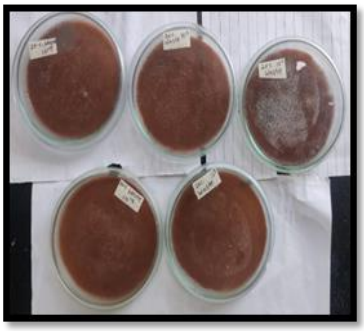


Table 3:: Gram Nature of organisms isolated on 20 % conc. Fil. media plates

Sr.no	Concentration	Gram nature	Shape
1	**10^{-2}** Conc	Gram Positive	**Cocci**
2	**10^{-3}** Conc	Gram Positive	**Cocci**
3	**10^{-4}** Conc	Gram Positive	**Cocci**
4	**10^{-5}** Conc	Gram Positive	**Cocci**
5	**10^{-6}** Conc	Gram Positive	**Cocci**

20% waste media:

Fig no: 8 (20% waste plates) ***(20% waste slants)***



Gram staining:

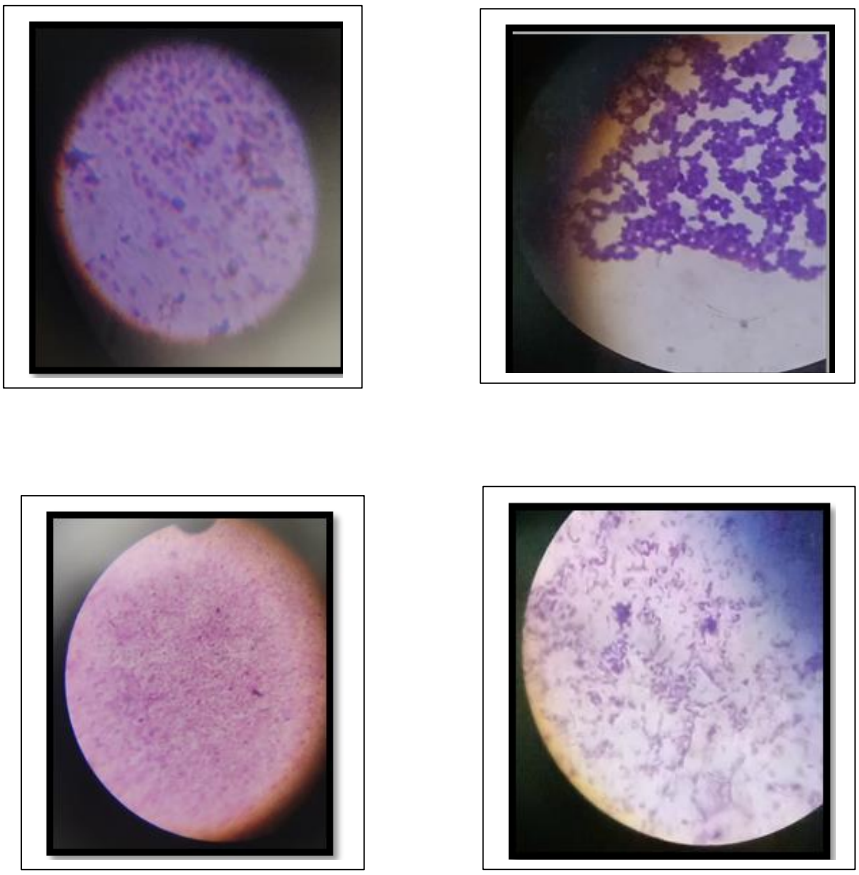


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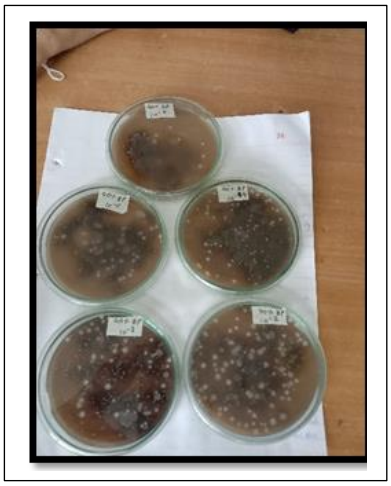
Table 4:: Gram Nature of organisms isolated on 20 % conc. waste media plates

Sr.no	Concentration	Gram Nature	Shape
1	**10^{-2}** Conc	Gram Positive	**Cocci**
2	**10^{-3}** Conc	Gram Positive	**Cocci**
3	**10^{-4}** Conc	Gram Positive	**Rod**
4	**10^{-5}** Conc	Gram Positive	**Rod**
5	**10^{-6}** Conc	Gram Positive	**Cocci**

For 40% concentration:

40% filtrate media:

Fig no: 9 (40% filtrate plates) *(40 % filtrate slants)*



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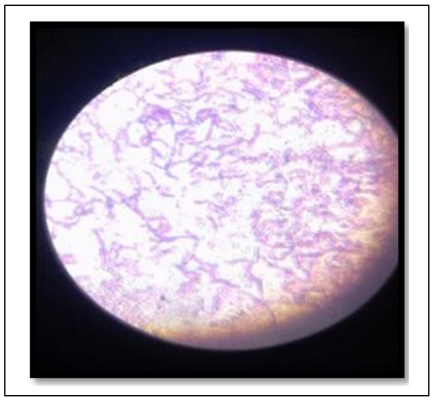
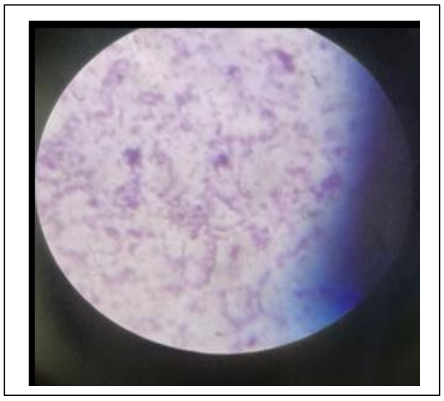
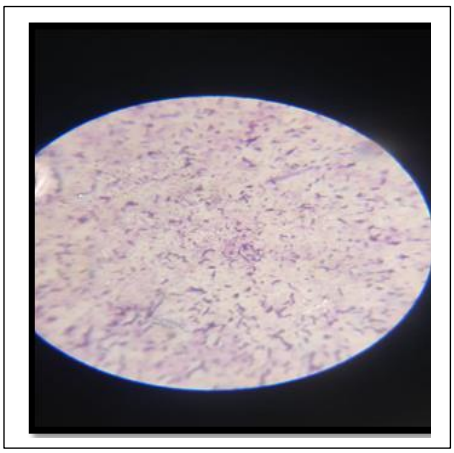






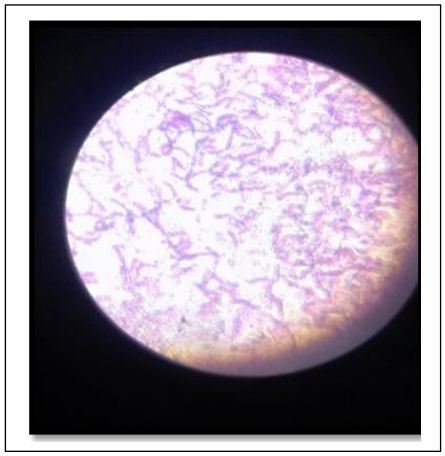
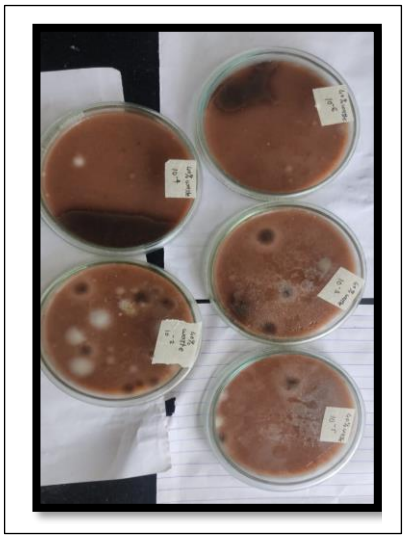


Table 5 : Gram Nature of organisms isolated on 40 % conc. fil. media plates

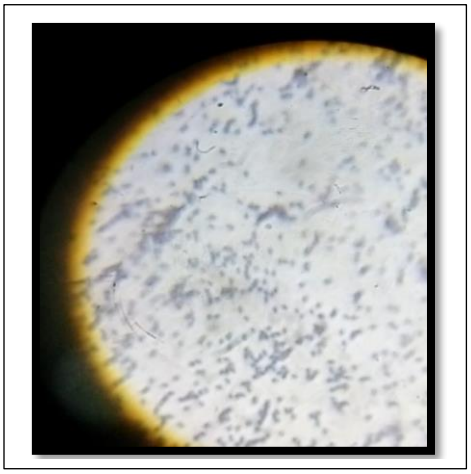
Sr. No	Concentration	Gram Nature	Shape
1	**10^{-2}** Conc	Gram positive	**Rod**
2	**10^{-3}** Conc	Gram positive	**Cocci**
3	**10^{-4}** Conc	Gram positive	**Cocci**
4	**10^{-5}** Conc	Gram positive	**Rod**
5	**10^{-6}** Conc	Gram positive	**Rod**

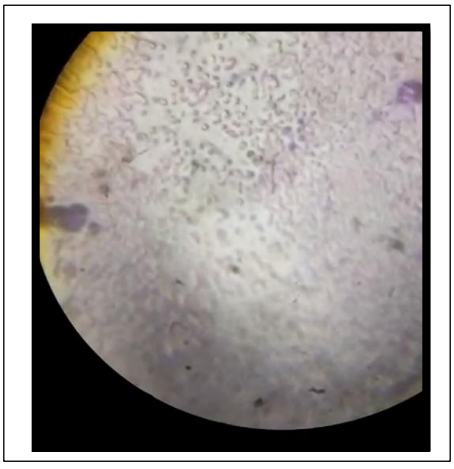
40% Waste Media:

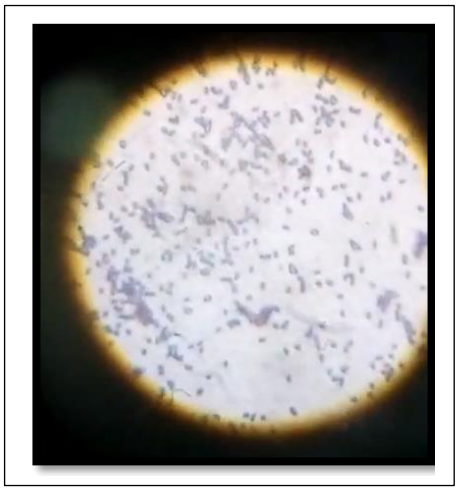
Fig no:10 (40% waste plates) *(40% waste slants)*



Gram Staining:







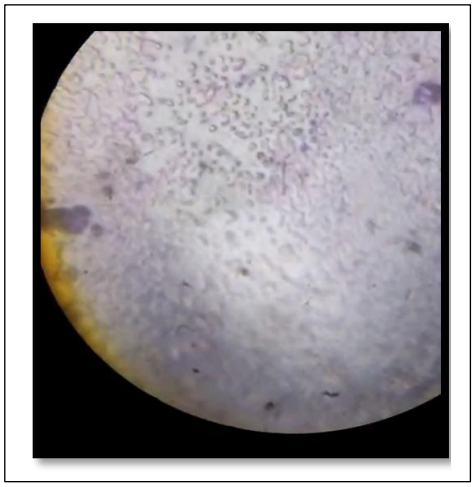


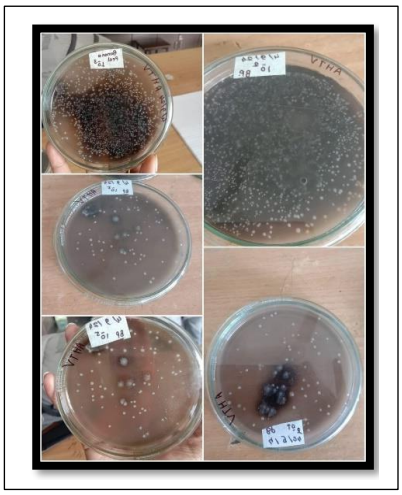
Table 6 : Gram Nature of organisms isolated on 40 % conc. waste media plates

Sr. No	Concentration	Gram Nature	Shape
1	**10^{-2}** Conc	Gram Positive	**Cocci**
2	**10^{-3}** Conc	Gram Positive	**Cocci**
3	**10^{-4}** Conc	Gram Positive	**Cocci**
4	**10^{-5}** Conc	Gram Positive	**Cocci**
5	**10^{-6}** Conc	Gram Positive	**Cocci**

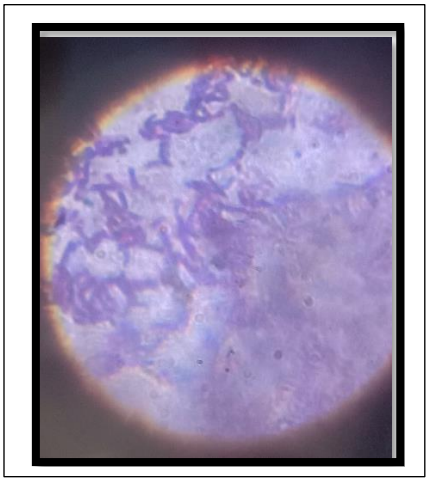
For 60% concentration:

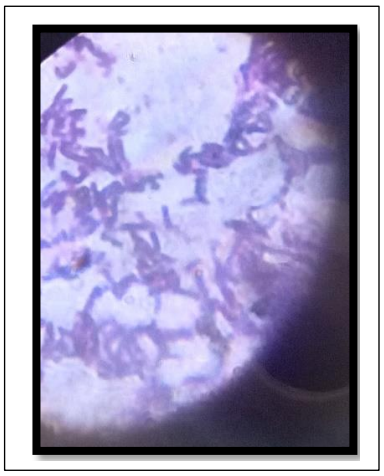
60% Filtrate Media:

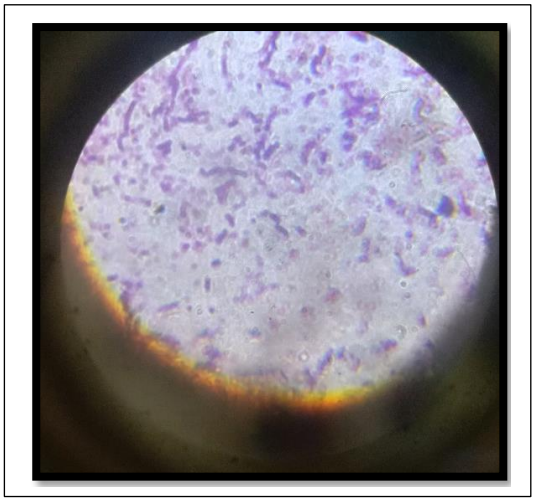
Fig no: 11 (60% filtrate plates)	*(60% filtrate slants)*



Gram Staining:







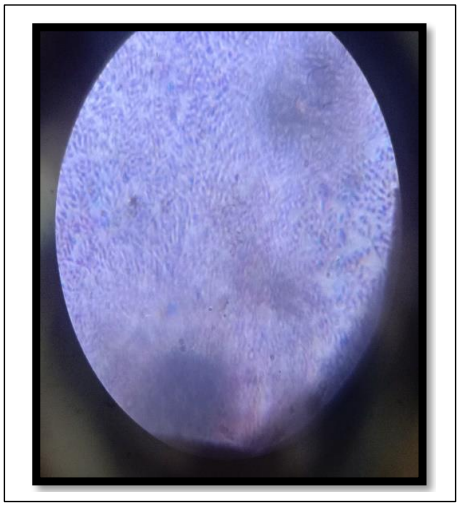
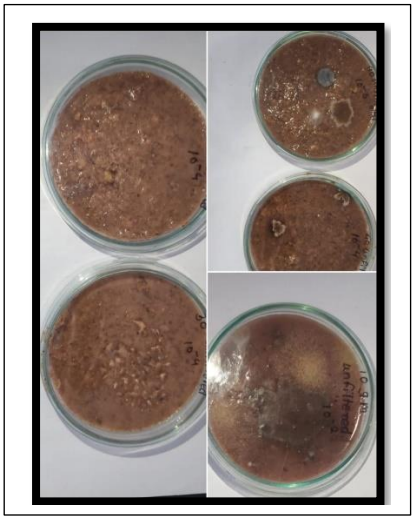


Table 7 : Gram Nature of organisms isolated on 60 % conc. fil. media plates

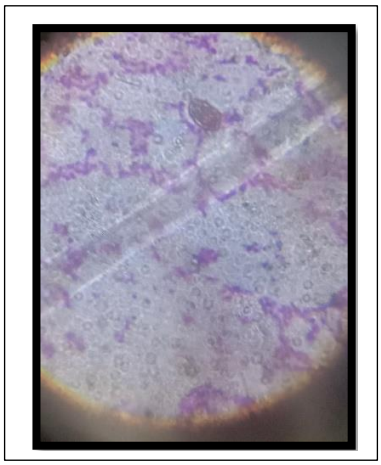
Sr. No	Concentration	Gram Nature	Shape
1	**10^{-2}** Conc	Gram Positive	**Rod**
2	**10^{-3}** Conc	Gram Positive	**Rod**
3	**10^{-4}** Conc	Gram Positive	**Rod**
4	**10^{-5}** Conc	Gram Positive	**Short Rod**
5	**10^{-6}** Conc	Gram Positive	**Cocci**

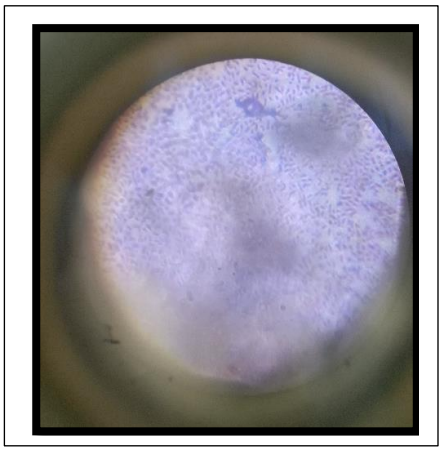
60% Waste Media:

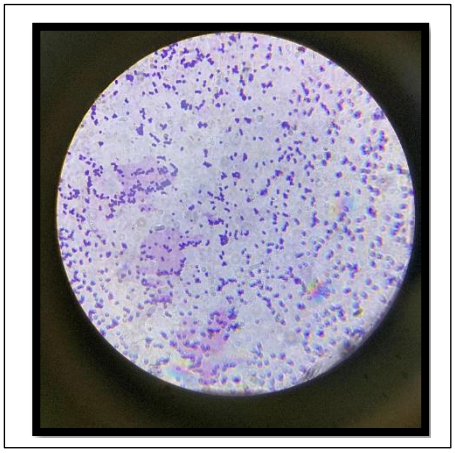
Fig no: 12 (60% waste plates) (60% waste slants)



Gram Staining:







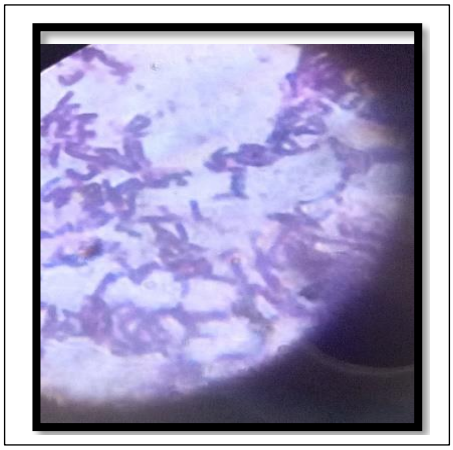


Table 8 : Gram Nature of organisms isolated on 60 % conc. waste media plates

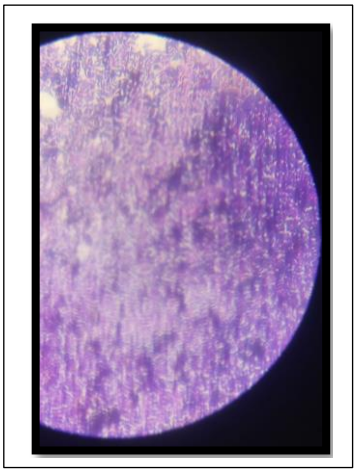
Sr. No	Concentration	Gram Nature	Shape
1	**10^{-2}** Conc	Gram Positive	**Rod**
2	**10^{-3}** Conc	Gram Positive	**Cocci**
3	**10^{-4}** Conc	Gram Positive	**Cocci**
4	**10^{-5}** Conc	Gram Positive	**Rod**
5	**10^{-6}** Conc	Gram Positive	**Cocci**

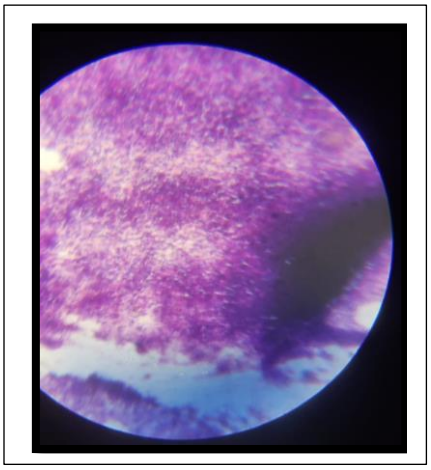
For 80% Concentration:

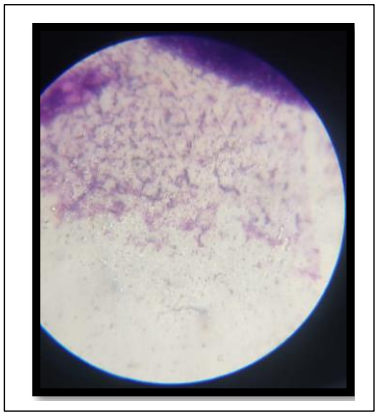
80% conc. Filtrate:

Fig no: 12 (80% filtrate plates) *(80% filtrate slant)*

Gram Staining:







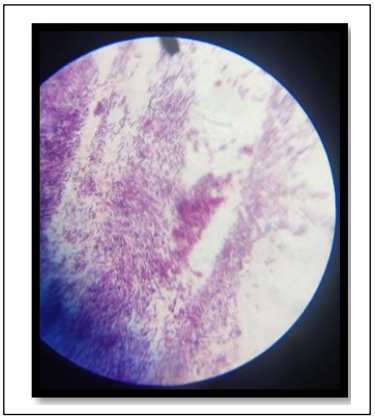
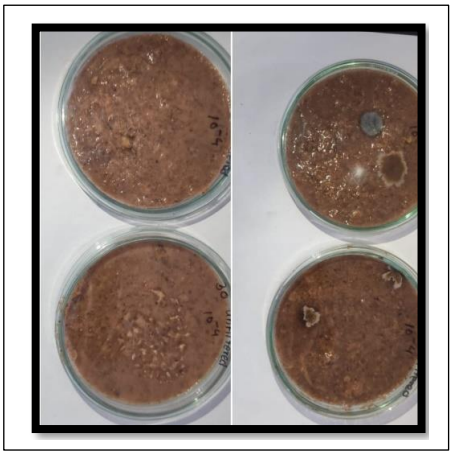


Table 9 : Gram Nature of organisms isolated on 80 % conc. fil. media plates

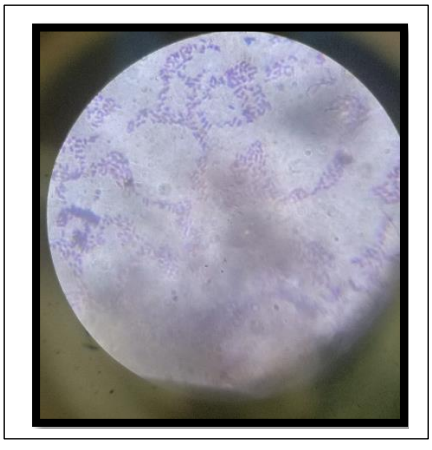
Sr. No	Concentration	Gram Nature	Shape
1	**10^{-2}** Conc	Gram Positive	**Rod**
2	**10^{-3}** Conc	Gram Positive	**Cocci**
3	**10^{-4}** Conc	Gram Positive	**Rod**
4	**10^{-5}** Conc	Gram Positive	**Cocci**
5	**10^{-6}** Conc	Gram Positive	**Rod**

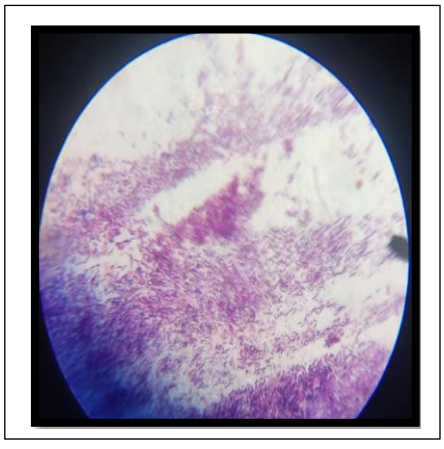
80% concentration Waste:

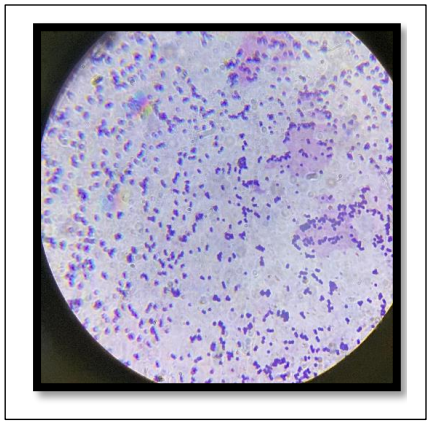
Fig no:13 (80% waste plates) (80% waste slants)



Gram Staining:







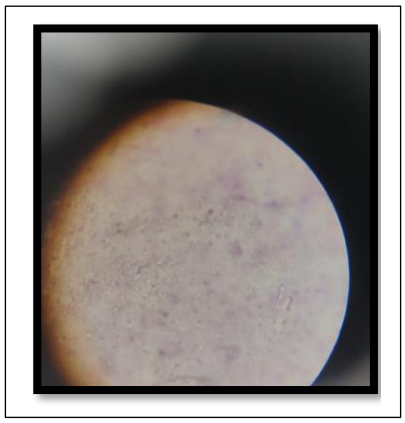


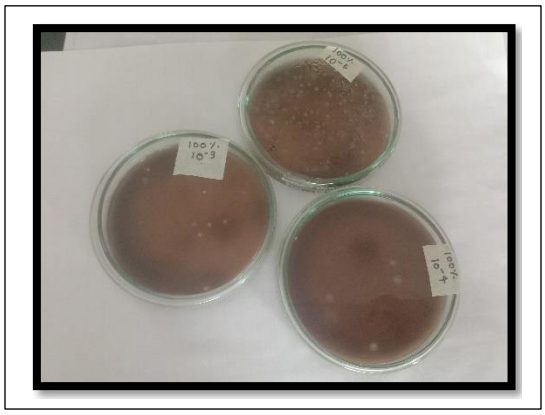
Table 10 : Gram Nature of organisms isolated on 80 % conc. Waste media plates

Sr. No	Concentration	Gram Nature	Shape
1	**10^{-2}** Conc	Gram Positive	**Cocci**
2	**10^{-3}** Conc	Gram Positive	**Cocci**
3	**10^{-4}** Conc	Gram Positive	**Rod**
4	**10^{-5}** Conc	Gram Positive	**Cocci**
5	**10^{-6}** Conc	Gram Positive	**Rod**

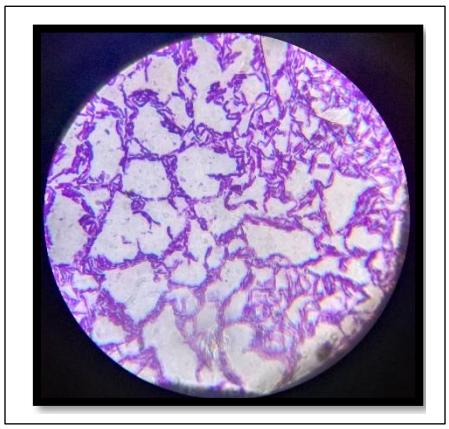
For 100% concentration media:

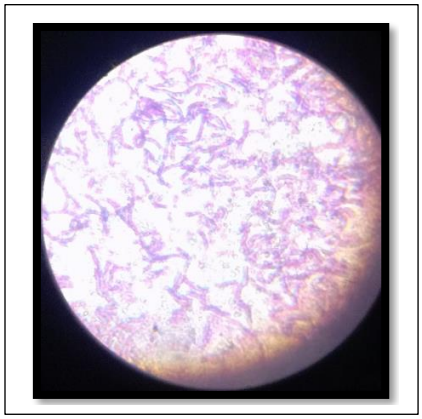
100% conc. Filtrate:

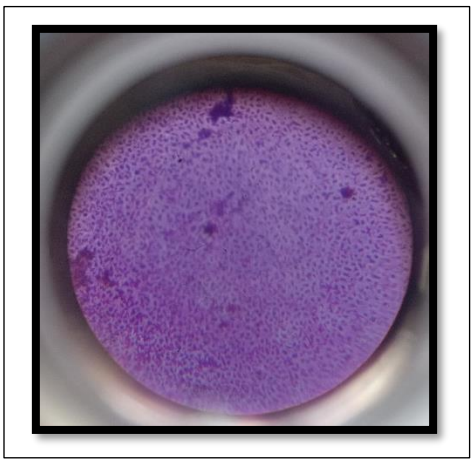
Fig no: 13 (100% conc. Filtrate plates) *(100% conc. Slant)*



Gram Staining:







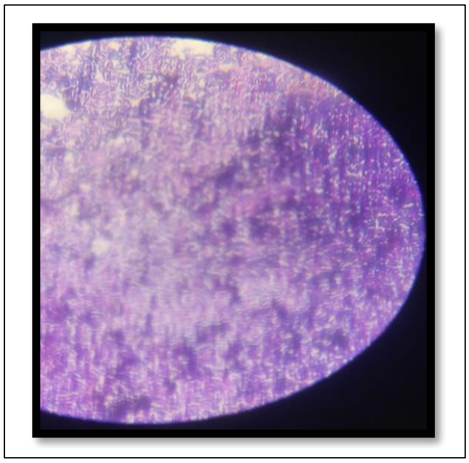


Table 11 : Gram Nature of organisms isolated on 100 % conc. fil. media plates

Sr. No	Concentration	Gram Nature	Shape
1	**10^{-2}** Conc	Gram Positive	**Rod**
2	**10^{-3}** Conc	Gram Positive	**Rod**
3	**10^{-4}** Conc	Gram Positive	**Rod**
4	**10^{-5}** Conc	Gram Positive	**Cocci**
5	**10^{-6}** Conc	Gram Positive	**Rod**

DISCUSSION

Discussion-

Banana is one of the most widely consumed fruits in the world, and its cultivation generates a significant amount of waste, primarily in the form of banana peels. Banana peels, often discarded as agricultural or household waste, account for nearly 30-40% of the total fruits weight. Despite being treated as waste, banana peels are rich in nutrients, organic compounds, and materials, making them a potential resource for sustainable applications.

- Banana peel waste material is a significant concern globally, with millions of tons generated annually. The disposal of banana peels in land-fills contributes to greenhouse gas emission and water pollution. However, banana peels are reach in nutrients, making them a valuable resource for sustainable applications.
- The presence of diverse microorganisms in banana peel waste highlights its potential as rich source of beneficial microorganism for various, biotechnological application
- The isolation of *Pseudomonas, fluorescens, bacillus subtills* and *aspergillus Niger* from banana peel waste support the theory that this waste material can be utilized as a nutrient - rich substrate for microbial growth
- The results of this study demonstrate the feasibility of using banana peel waste as a cost-effective and sustainable feedstock a for the production of biodegradation agents and other value -added products.
- The finding of this study underscores the important of proper waste management practices, particularly for organic waste material like banana peel waste, which can be converted into valuable resource through microbial fermentation and other biotechnological processes.
- The result indicates the presence of diverse microorganism in banana peel waste include *pseudomonas fluorescence, staphylococcus aureus, bacillus subtilis ,aspergillus Niger and saccharomyces cerevisiae* these microorganisms have potential application in biodegradation.
- Despite these opportunities, there are several challenges associated with utilizing banana peel waste. One major hurdle is the lack of infrastructure for collecting and processing banana peel. Furthermore, the high moisture content of banana peel makes them prone to spoilage, requiring specialized storage and handling facilities.

- To overcome these challenges, innovative solutions such as mobile processing units and decentralized waste management system are being developed. Moreover, researchers are exploring new technologies to enhance the shelf life and value of banana peel waste Challenges like collection, processing and cost effectiveness remain barriers to fully utilizing this resource.

Table 12 Price list of media:

Sr. No	Name of Media	Price
1	Banana peel agar 500kg)	430rs
2	Nutrient agar (500g)	5,700rs
3	MacConkey's agar(500g)	4,449rs
4	Blood agar (500g)	6,269rs
5	Potato Dextrose agar(500g)	5,300rs
6	Sabouraud dextrose agar(500g)	3,415rs
7	Yeast Extract (500g)	3,575rs

Table 13 Price list of Banana peel agar

Peels waste	No cost
Agar -agar	430rs

Applications of Banana Peel-Based Agar:

- Microbiological Cultures: This agar substitute can be used for growing microorganisms in laboratories, similar to traditional agar.
- Food Industry: In the food industry, it may be used as a gelling agent in products like jellies, jams, and desserts.
- Waste Valorization: By using banana peel waste, this process helps in reducing waste and converting it into a valuable resource, aligning with sustainable practices.

Challenges and Considerations:

- Consistency of Gel Formation: The quality and consistency of the gel formed may vary depending on factors such as the banana variety, peel maturity, and extraction method.
- Optimization: The process might require further optimization in terms of temperature, concentration, and additional ingredients to improve gel strength and performance.
- Regulatory Standards: The use of banana peel-based agar for medical or food applications may need to meet certain regulatory requirements and safety standards.

CONCLUSION

conclusion-

Banana peel waste material, a readily available and abundant by product of the banana industry poses significant environmental challenges but also present opportunities for sustainable utilization and valorization. In conclusion this study demonstrates the potential of microorganisms with application biodegradation and bioremediation. The finding of this study highlights the important of exploring alternative waste management strategies that utilize microorganism to convert organic waste into valuable resources.

Overall, this research provides valuable insight into the microbiological characteristics of banana peel waste and its potential application in environmental biotechnology. The results of this study suggest that banana peel waste can be effectively utilize the as a nutrient -rich substrate for microbial growth paving the way for the development of sustainable waste management practices

In summary this project demonstrates the feasibility of using microbiological techniques to isolate and identify microorganism from banana peel waste with potential application in biotechnological and environmental sustainability. The conclusion drawn from this study emphasize the need for further research into the microbiological aspects of banana peel waste management with focus on developing innovative and sustainable solutions.

- **Future Directions**:

Further research is needed to investigate the potential applications of microorganisms are isolated from banana peel waste in agricultural environmental remediate and biotechnology.

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