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# NOVEL ANTIMICROBIAL HANDWASHING GEL USING BANANA PEEL & CONDUCTING, IT'S HOW TO USE CAMPAIGN

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## ABSTRACT

This study explores the formulation and evaluation of a handwashing gel containing banana peel extract, focusing on its antimicrobial activity and the dissemination of awareness regarding the importance of using antimicrobial handwashing gel. The research involves the development of the gel formulation incorporating banana peel extract, followed by rigorous evaluation of its efficacy in inhibiting microbial growth. Various parameters such as pH, cleaning, and stability are assessed to ensure the gel's effectiveness and safety for use. Additionally, the antimicrobial activity of the gel is examined against common pathogens to validate its efficacy in promoting hand hygiene. Furthermore, efforts are made to spread awareness about the significance of using antimicrobial handwashing gel in preventing the spread of infectious diseases, emphasizing its role in maintaining public health. This research aims to contribute to the development of effective hand hygiene products while promoting public awareness and education regarding the importance of proper hand hygiene practices in disease prevention.

**KEYWORDS:** Handwashing Gel, Banana Peel Extract, Antimicrobial Activity, Awareness.

## 1. INTRODUCTION

### 1.1. Banana Peels: A Waste Treasure for Human Being[1]

Banana (Musa spp., Musaceae family) is a prominent fruit crop grown for its edible fruits in tropical and subtropical regions. The average weight of the fruit is about 125 grams, with roughly 75% being water and 25% dry matter. Ripe bananas come in various sizes and colours, including yellow, purple, and red. Most culinary bananas are seedless, although wild

varieties bear fruits containing numerous large and hard seeds. The peel of the banana constitutes the outer covering of the fruit and is a residual product of household consumption and banana processing. It finds utility as animal fodder, although there are apprehensions regarding the impact of tannin present in the peels on the animals' health. Banana peels serve multiple purposes, including culinary applications, water purification, the production of various biochemicals, and the generation of inorganic waste. Additionally, banana peels are occasionally utilized as feed for a diverse range of animals.

### 1.2. Plant Profile : Banana Plant[5,6,7,8]

1) Bananas, belonging to the Musaceae family, represent one of the most prevalent fruit crops globally and serve as ancient remedies for treating various infections. Recent attention has been directed towards assessing the efficacy of its natural active constituents, particularly theantimicrobial properties.
2) Within this plant, a diverse array of antimicrobial agents can be found, such as dopamine, gentisic acid, ferulic acid, lupeol, and 3-carene.
3) As one of the earliest cultivated plants, bananas have been utilized for medicinal purposes across all their parts:
4) The flowers are used in treating bronchitis and dysentery, and as a remedy for ulcers.
5) The astringent sap of the plant finds application in managing conditions such as hysteria, epilepsy, leprosy, fevers, haemorrhages, acute dysentery, and diarrhoea. Additionally, it is applied topically on haemorrhoids, insect bites, and other stings.

**Table 1: Systematic Classification.**

| Systematic Classification | Class |
|---|---|
| Division | Spermatophyta |
| Subdivision | Angiospermae |
| Class | Monocotyledonae |
| Series | Epigynae |
| Family | Musaceae |
| Genera | Musa Sp. |

### 1.3. Hand Washing Gel[2]

A solution containing alcohol (liquid, gel, or foam) designed for use on hands to deactivate microorganisms and/or temporarily hinder their growth. Gels are characterized as somewhat rigidstructures wherein the mobility of the liquid medium is constrained by an intricate three-dimensional arrangement of particles or dissolved macromolecules of the dispersed phase. The term 'gel' originates from 'gelatin,' and both 'gel' and 'jelly' trace back to the Latin word

'gelu' meaning 'frost' and 'gelare,' meaning 'freeze' or 'congeal.' This etymology suggests the fundamentalconcept of a liquid transforming into a solid-like substance that doesn't flow but possesses elasticity and retains some liquid properties. The use of 'gel' as a categorization emerged in the late 1800s when chemists endeavored to categorize semi-solid materials based on their observable traits rather than their molecular structure. The USP defines gels (sometimes referred to as jellies) as semi-solid systems containing either suspensions composed of small inorganic particles or largeorganic molecules penetrated by a liquid. If the gel mass contains a network of small separate particles, it is termed as a two-phase system. In a two-phase system, when the dispersed phase's particle size is relatively large, the gel mass is occasionally referred to as magma. Single-phase gels comprise organic macromolecules uniformly dispersed throughout a liquid in a manner that doesn't show clear boundaries between the dispersed macromolecules and the liquid.

### 1.4. Noscomial Infections In Health Care Sector[3]

During dental treatments, dentists' hands transmit microorganisms among individuals, but cross- contamination can be prevented with responsibility from all healthcare workers (HCWs). Hand hygiene is crucial for infection control, as improper hand hygiene by HCWs contributes to about 40% of nosocomial infections. Bacteria are the most prevalent microorganisms on hands (>80% relative abundance), followed by viruses and fungi. HCWs' hands often harbor pathogenic microorganisms like Staphylococcus aureus, Enterococcus spp., and Candida albicans. Bacterial colony-forming units (CFUs) on HCWs' hands range from 3.9 × 104 to 4.6 × 106 CFU/cm2, with fingertip contamination ranging from 0 to 300 CFUs. S. aureus is a major cause of community andhospital-acquired infections. The World Health Organization (WHO) issued guidelines for properhandwashing, emphasizing routine handwashing with water and nonantimicrobial soap to remove unsanitary and transient microorganisms, while handwashing with antimicrobial agents aims to kill or reduce pathogens. 4% chlorhexidine gluconate (CHG) is a commonly used antimicrobial agent nowadays.

### 1.5. Antimicrobial Properties of Banana Peel[4]

Banana peels contain various antimicrobial substances, such as dopamine, gentisic acid, ferulic acid, lupeol, and 3-carene. Despite limited research on their application as bio-preservatives in food products, they represent a natural reservoir of both antimicrobial and antioxidant agents. This characteristic presents an environmentally friendly alternative to

traditional antibacterial and fungicidal agents, offering potential benefits over chemical options. Implementing cost- effective techniques to extract these compounds from banana waste could enhance food storagemethods and facilitate the development of value-added bio-packaging solutions for perishable goods.

### 1.6. Hand washing helps battle the rise in antibiotic resistance[4]

Preventing illness diminishes the quantity of antibiotics utilized and the probability of antibioticresistance emergence. Hand hygiene is effective in averting approximately 30% of diarrhea- related illnesses and around 20% of respiratory ailments (e.g., common colds). Antibiotics are frequently prescribed unnecessarily for such medical conditions. Decreasing the incidence of these infections through regular hand washing aids in curbing antibiotic overutilization—the primary contributor to global antibiotic resistance. Additionally, hand hygiene can thwart individuals from contracting illnesses caused by bacteria that have already developed resistanceto antibiotics, posing challenges for treatment.

### 1.7. WHO (Hand Washing Protocol)[3]

Start from wetting hands with water, apply the hand washing product in a palm to cover all handsurfaces. Then follow these steps:

1. Rub hands palm to palm.
2. Right palm over left dorsum with interlacedfingers and vice versa.
3. Palm to Palm with fingers interlaced.
4. Backs of fingers to Opposing palms with fingersinterlocked.
5. Rotational rubbing of left thumb clasped in right palm and vice versa.
6. Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm andvice versa.
7. Rinse Hands with water and dry thoroughly with a towel or napkin.


**Figure 1: WHO Handwashing Protocol.**

## 2. MATERIALS AND METHODS

### 2.1. Objective

The Present work is to Formulate and Evaluate Hand washing Gel Containing Goodness and Antimicrobial Effect of Banana Peel Extract.

- To Prepare Physically Stable Formulation Containing Banana Peel Extract.
- To Increase User's Compliance towards use of Antimicrobial Hand washing Gel.
- Being Able to Utilize the Banana Peel which is considered as Waste.
- To Spread Awareness Regarding Hand Hygiene & Use of Antimicrobial Hand Washing Gel.

### 2.2.Plan of Work

- Literature Review.
- Searching waste matter having potential to prepare cosmetic preparation.
- Collection of all Ingredients required for the preparation.
- Antimicrobial activity testing of Banana Peel Extract.
- Formulation of Hand washing Gel Preparation.
- Evaluation of Hand washing Gel Preparation.
- Compilation of data.

### 2.3. Material and Chemicals

**Table 2: Materials and Chemicals.**

| | |
|---|---|
| **Apparatus :** | Beaker, Stirrer, Measuring Cylinder (10 ml, 20 ml, 100 ml) Petri Plates, Cork Borers, Water Bath, Burner, Sieves, Test Tubes, Laboratory Tongue, Cotton, Knife, etc. |
| **Instruments :** | Weighing Balance, Digital pH meter, Incubator, Autoclave etc. |
| **Chemicals :** | Peptone, Meat Extract, Sodium Chloride, Agar, Distilled Water, Carbopol Ulterz 940, Triethanolamine, 95 % Ethanol. |
| **Ingredients :** | Banana Peel to Prepare Banana Peel Extract. |

### 2.4. Experimental Work and Result

#### 2.4.1. List of Ingredients Required with their Specified Quantity

**A] For Hand Washing Gel Preparation.**

**Table 3: Ingredients for Hand Washing Gel Preparation.**

| Sr. No. | Ingredients | Quantity Taken (200 ml) |
|---|---|---|
| 1. | Banana Peel Extract | 120 ml |
| 2. | Carbopol Ulterz 940 | 6 gm |
| 3. | Triethanolamine | 6 ml |

| | | |
|---|---|---|
| 4. | Ethanol 95% | Quantity Sufficient To Make Up Volume of 200 ml. |

**B] For Banana Peel Extract Preparation.**

**Table 3: Ingredients for Banana Peel Extract Preparation.**

| Sr. No. | Ingredients | Quantity Taken ( 1000 ml) |
|---|---|---|
| 1. | Banana Peel | 200 gm |
| 2. | Distilled Water | Quantity Sufficient To Make Up The Volume of 1000 ml |

**C] For Antimicrobial Testing.**

**Table 4: Ingredients for Antimicrobial Testing.**

| Sr. No. | Ingredients | Quantity Taken (100 ml) |
|---|---|---|
| 1. | Agar | 2 gm |
| 2. | Beef Extract | 1 gm |
| 3. | Peptone | 1 gm |
| 4. | Sodium Chloride | 0.5 gm |
| 5. | Distilled Water | Quantity Sufficient To Make Up The Volume of 100 ml |

**2.5.Methodology For Preparation**

**A] Procedure For Banana Peel Extract Preparation[3]**

1. Banana Peel used for formulation purpose procured from the local road side vendor from the nearbymarket.

**Figure 2: Banana.**

2. Specified weight of 200 gm of Banana Peels were weighed.

**Figure 3: Banana Peels.**

3. Banana peels were washed with running tap water and surface were sterilized using 70 % ethanol.

**Figure 4: Sterilizing Banana Peel.**

4. Cut the Banana Peels into Small Sized Pieces, Rinse with Sterile Water.

**Figure 5: Cutted pieces of Banana Peels.**

5. Put rinsed banana peels into 1000 ml boiling distilled water.

**Figure 6: Boiling Banana Peels.**

6. After Boiling the peels they were left to macerate for about 24 hours at room


**Figure 7: Maceration at Room Temperature temperature.**

7. After 24 hours the contents were mixed by the blender and filtered with muslin cloth and thenrefilltered with filter paper the filtrate (banana peel extract) was obtained near about 750 ml.

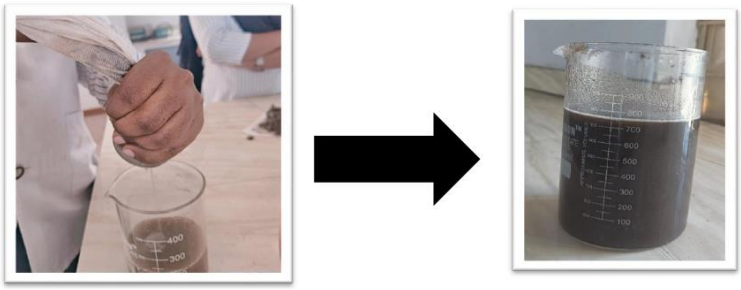

**Figure 8: Filtration of Banana Peel Extract.**

8. **Obtained Product was stored at cool storage until use B] Procedure For Antimicrobial Activity Assay**

a) Procedure for Preparation and Sterilization of Nutrient Agar Media[9]

1. Weigh all ingredients accurately and dissolve in water.
2. Adjust PH of media using 1 N HCL or IN NAOH.
3. Media is heated on water bath to dissolve all ingredients till to get clear yellow coloured liquid.
4. Pour the agar into conical flask and plug it with cotton swab.
5. Conical flask is placed in autoclave for sterilization of media.
6. Media is sterilized at temperature of 121°C at 15 lbs pressure for 15 minutes.
7. Sterilization of all glassware during same time.
8. After sterilization allow it to cool at moderate temperature and transfer to aseptic place.

9. Disinfectant the working platform and take two burners.
10. Culture media & glassware's placed to aseptic area.
11. Pour sterilized media from conical flask into petridish and allowed it to solidify.
12. Pour sterilized media from conical flask into petridish allow it to solidify to get cleared solidifiedsurface.

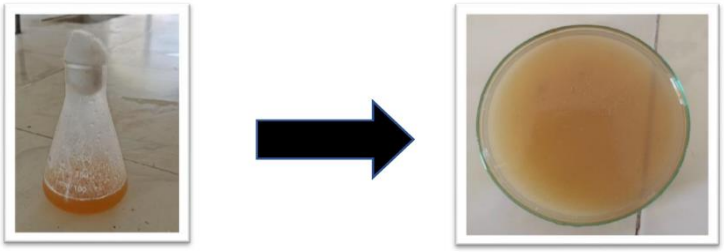

**Figure 9: Pouring Content of Conical Flask to Petri Plate.**

**b) Procedure used for Conduction of Antimicrobial Activity[9]**

1. The Determination of Antimicrobial was done using the agar well diffusion technique.
2. Take 100 ml of Banana Peel Extract and mark it as a stock solution.
3. By using the above prepared stock solution different concentration of extract with distilled water wereprepared.
4. Mainly 5 concentration was prepared : 50 %, 60%, 70%, 80%,90 % respectively.
5. Sterilize the assay medium by autoclave and Petri plates wasprepared in aseptic areas.
6. Spread the test micro-organism (Staphylococcus Aureus) on thesurface of agar medium by spread plate method or per plate method.
7. Prepared cup or cavities 5 on plate with sterile cork borer keeping adequate.
8. Test solution depending on size of cavity or cylinder is added in each level of the plate.
9. Transfer the plate to the refrigerator for proper diffusion of antibiotics at 4°C for 1 to 2hrs
10. Incubate the plate in the incubator at 32°C to 35°C for 24 to 28 hrs.

**Figure 10: Cork Borrer.**

**Figure 11: Whole Procedure of Antimicrobial Testing.**

**Table 6: Antimicrobial Testing Observations.**

| Sr. No. | Concentration | Zone of Inhibition |
|---|---|---|
| 1. | 50% | 17.5 mm |
| 2. | 60% | 18.2 mm |
| 3. | 70% | 19.8 mm |
| 4. | 80% | 21.9 mm |
| 5. | 90% | 22.1 mm |

**C] Handwashing Gel Preparation**

1. Accurately weigh 6 gm of Carbopol Ulterz 940 which is a gelling agent and suspend it in the 120 mlof banana peel extract with constant stirring to get the homogeneous mixture.
2. After Carbopol getting suspended, then gently add 6 ml of Triethanolamine (TEA) with slow stirringto avoid formation of possible air bubbles in the mixture.
3. After which the preparation mixture were kept aside for about 24 hours.
4. After 24 hours 95% of Ethanol was added to provide 200 ml mixture.
5. The prepared product was thoroughly mixed until getting the homogeneous gel.
6. After preparation of product green colour as an colourant was added and labelled for user'scompliance.

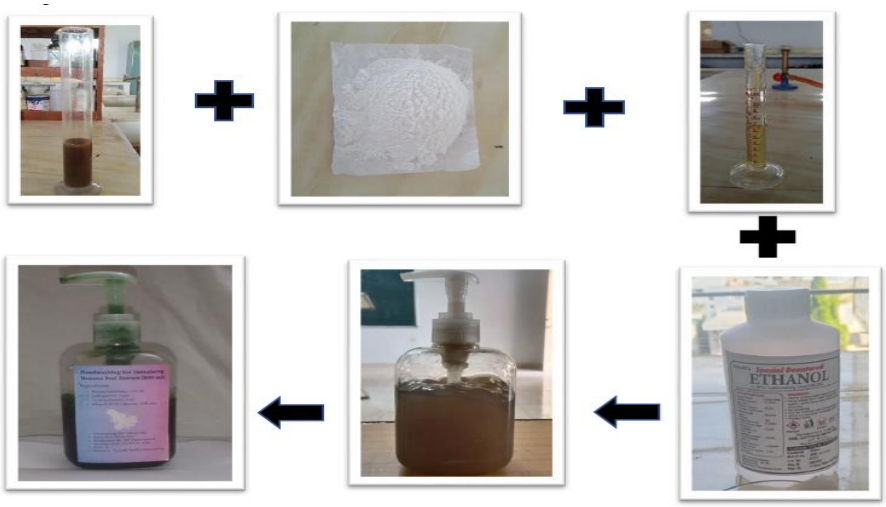


**Figure 12: Flow Chart for Handwashing Gel Preparation.**

### 2.6. Evaluation Parameters For Hand Washing Gel Preparation[10]

1. Organoleptic Properties
- Colour
- Odour
- Texture
- Consistency
- Physical State
2. Appearance and Homogeneity.
3. pH
4. Spreadability
5. Foam Height
6. Cleansing Action

**1. Organoleptic Properties**

**Table 7: Organoleptic Properties of Formulation.**

| Sr. No. | Parameters | Observations |
|---|---|---|
| 1. | Colour | Greenish in Colour |
| 2. | Odour | Pleasant Smell |
| 3. | Texture | Slippery |
| 4. | Consistency | Viscous Gel |
| 5. | Physical State | Gel |

**2. Apperance and Homogeneity**

a. Appearance and Homogeneity was evaluated by the visual inspection. Observations: Prepared hand washing gel was found to be homogeneous in nature.

**3. pH**

1gm of Sample of Hand Washing Gel was taken and dissolved it into 100ml distilled water. The pHsolution was measured by standardized digital pH meter**.**

**Figure 13: pH testing of gel using digital pH meter.**

- Observations: pH was found to be 6.61.

**4. Spreadability**

a. Accurately weigh 0.5gm of Sample of Hand washing Gel was pressed between two slides andleft for about 5 minutes where no more spreading was expected.

b. Diameter of spreaded circle was measured in cm and was taken as comparative values forspreadability.

**Table 8: Spreadability Testing.**

| Sr. No. | Weight | Spreadibilty |
|---|---|---|
| 1. | 20 gm | 3.2 cm |
| 2. | 100 gm | 4.7 cm |

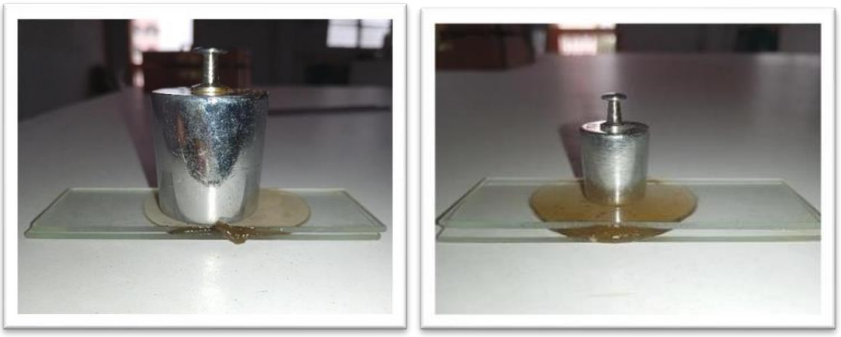

**Figure 14: Weight (100 gm, 20 gm) on slide containing preparation.**

5. Foamability

a. One gram of sample of Hand washing Gel was taken and dispersed in 50ml distilled water.

b. Dispersion was transferred into measuring cylinder. Volume was made up to 100ml with water.

c. This solution is taken in 10 test tubes in a series of successive portion of 1, 2, 3.10ml and remaining volume is made up with water to 10ml.

d. Then the test tubes were shaken for 15 seconds.

e. Then the test tube is allowed to stand for 5 minutes.

f. The Height of foam was measured.

**Observations:** With the increase in concentration of hand washing gel preparation their was agradual increase in the foam height.

**6. Cleansing Action**

- Wool was taken and placed in Dirty Water, the same was then placed in a 200ml of water containing 1gm of Hand washing gel in a beaker and was shaken for 10 Minutes.
- The solution was removed and sample was taken out.
- Observations: The Hand washing gel was found to be able to clean 70 – 80 % of Dirtiness from the cotton wool cloth.

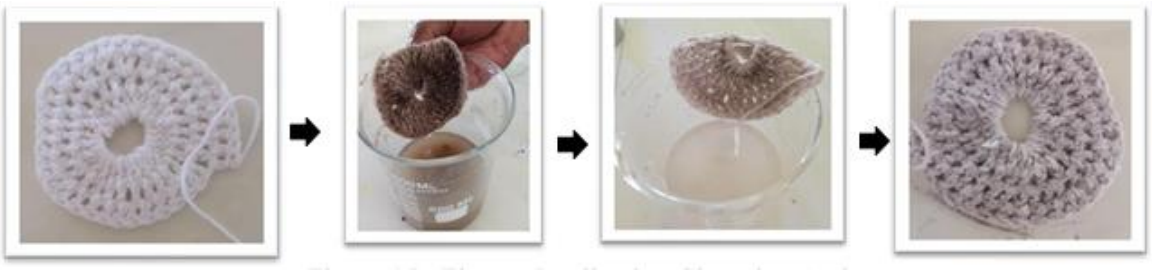

**Figure 15: Figures Implicating Cleansing Action.**

**2.7. Spreading Awareness Regarding "WHO Hand Washing Protocol".**

**"Survey On The Student's Awareness Regarding Use Of Antimicrobial Agents For HandWashing Purpose"**

- Awareness Program was conducted for promoting use of antimicrobial agents for hand washing purpose.
- Information about the WHO Hand washing Protocol were spread in B pharma Second, Third & Fourthyear by us.
- In this program we conducted a short seminar or speech of near about 5 minutes for the students by which they can figure out the basic information about outline of "WHO Hand washing Protocol" & Use of Antimicrobial Hand Washing Gel.
- Some of the volunteers from respective classes helped us.
- During Awareness Program Near about 130 + Students was present in respective classes.
- After the completion of Awareness Program a little bit survey was taken on the Students to understandhow effective was our short speech.
- In survey few questions were asked response was collected on the Google forms application in formof Pie Charts.

**Figure 16: Spreading Awarenesss.**

**Figure 17: Support from respective class volunteer.**

### A] Charts Represented During Awareness Program


**Figure 18: Charts Represented During Awareness Program.**

## B] Survey Data Obtained

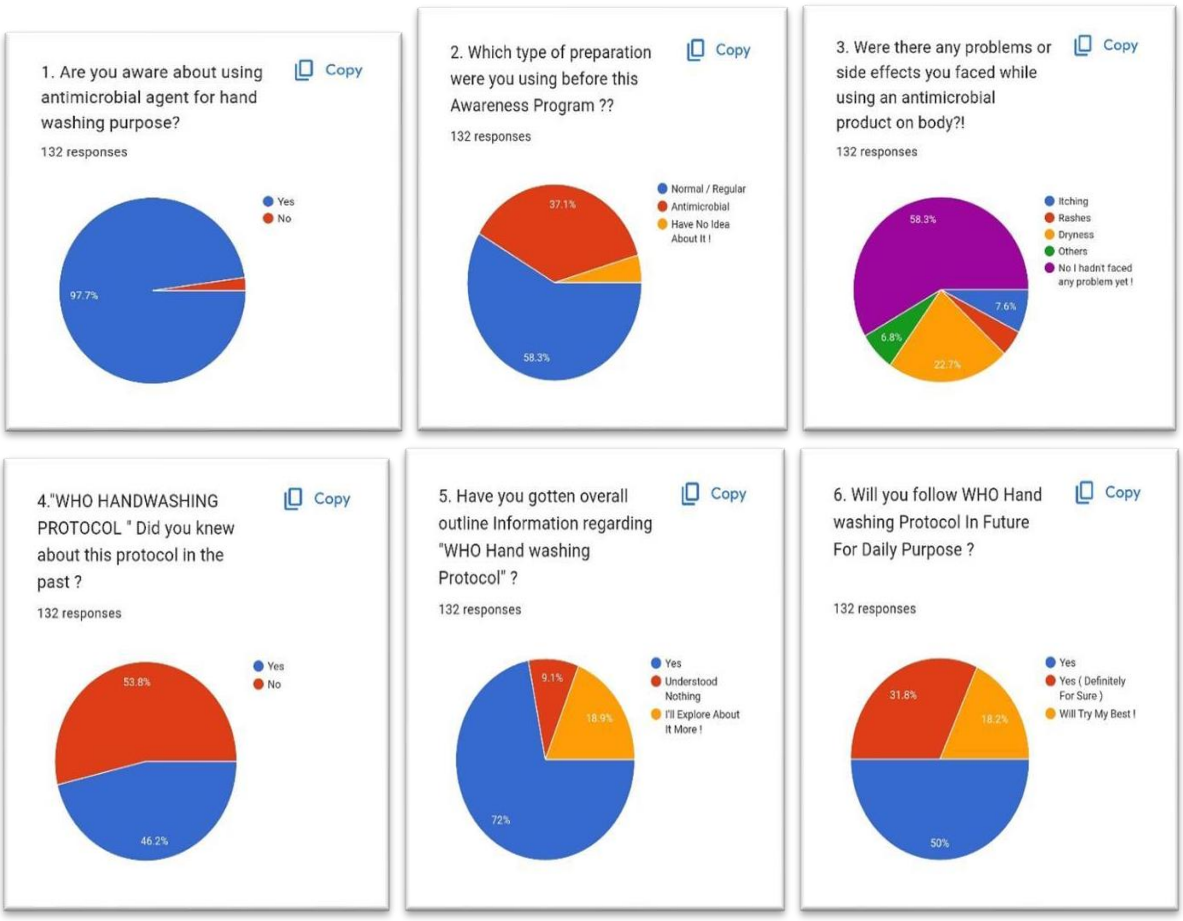


**Figure 19: Pie Charts Representing Survey Responses.**

## 3. RESULT AND DISCUSSION

- Hand washing gel containing banana peel extract was formulated and evaluated successfully.
- All cleansing agents for hands, including soaps and liquid hand cleaners, are primarily engineered tofacilitate the removal of grease, bacteria, and other impurities from the skin.
- Hand washing gels serve the purpose of eliminating dirt, debris, and bacteria from the hands.
- The aim of this research was to develop and assess a hand washing gel enriched with banana peel extract, comprising ingredients such as Carbopol 940, banana peel extract, 95% ethanol, and triethanolamine.
- Banana peel extract was procured by initially weighing 200g of banana peel, which was then washed with running water and sterilized using 70% ethanol. Subsequently, the peels were diced into small fragments, rinsed with sterile water, and immersed in 1000ml of boiling distilled water for macerationover a 24-hour period at room temperature.

- Following maceration, the contents were homogenized using a blender, filtered through muslin cloth,and further refined with filter paper. The resultant filtrate was preserved at low temperatures until application.
- To evaluate its antimicrobial efficacy, agar plates were prepared, and five concentrations of banana peel extract (50%, 60%, 70%, 80%, and 90%) were tested against Staphylococcus aureus. Cavity wellswere created using sterile cork borers, into which the test solutions were introduced. The plates were refrigerated at 4°C for 1-2 hours for diffusion, followed by incubation at 32-35°C for 24-28 hours.
- The hand washing gel was concocted by accurately measuring 6g of Carbopol Ulterz 940, a gelling agent, and dispersing it in 120ml of banana peel extract with continuous stirring to ensure homogeneity. Triethanolamine (TEA) (6ml) was then gently added to the suspension to prevent the formation of air bubbles.
- The mixture was left undisturbed for 24 hours, after which 95% ethanol was incorporated to yield a final volume of 200ml.
- Thorough mixing ensued until a uniform gel was achieved.
- The resulting homogeneous gel was packaged in plastic containers of 200ml capacity, facilitating easydispensing. Users can simply press the container's upper portion to extract the desired quantity of gel for handwashing, thereby promoting hand and overall hygiene.

## 4. CONCLUSION

- This research project aimed to develop and assess the efficacy of a hand washing gel incorporating banana peel extract, focusing particularly on its antimicrobial properties and promoting awareness regarding its usage.
- The objective was to investigate the antimicrobial effectiveness of banana peel extract. This was achieved by subjecting the formulated hand washing gel to testing against Staphylococcus aureus usingthe agar diffusion method.
- The formulated hand washing gel containing banana peel extract underwent thorough evaluation, revealing that it possessed a brownish color, pleasant odor, semi-solid consistency, and stability undervarious environmental conditions.
- Conclusively, based on our findings, the formulation of hand washing gel enriched with banana peel extract emerges as a preferable option for consumers. Its utilization not only minimizes potential side effects but also demonstrates antimicrobial activity, thereby promoting better hand hygiene practices.

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- Arpita V. Hendve.
- Pramod H. Saruk.

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