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FORMULATION AND EVALUATION OF HERBAL HAND SANITIZER

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ABSTRACT

The present study focuses on the formulation and evaluation of a polyherbal hand sanitizer using natural plant extracts such as Neem (*Azadirachta indica*), Tulsi (*Ocimum sanctum*), and Aloe vera. The increasing demand for safe and skin-friendly hygiene products has led to the development of herbal alternatives to conventional alcohol-based sanitizers. In this study, herbal extracts were prepared using suitable extraction methods and incorporated into a formulation containing ethanol, glycerin, and other excipients. The prepared sanitizer was evaluated for various physicochemical parameters including pH, viscosity, spreadability, drying time, and stability. The formulation showed a pH in the range of 6.2–6.8, indicating skin compatibility. It exhibited good consistency, pleasant odor, and easy spreadability with quick drying time. Antimicrobial activity was confirmed using standard microbiological methods, showing effective inhibition against common pathogens. No signs of skin irritation were observed during testing, and the formulation remained stable under different storage conditions. The presence of bioactive compounds in herbal ingredients contributed to antimicrobial activity, while Aloe vera provided moisturizing and soothing effects. Overall, the formulated herbal hand sanitizer was found to be effective, safe, eco-friendly, and suitable for regular use.

KEYWORDS

Herbal Hand Sanitizer , Poly Herbal Formulation, Bioactive Compound, Anti-Microbial.

INTRODUCTION

The skin is the part of the body that is most exposed to the sun, environmental contaminants, and defensive mechanisms against infections. The most common kind of skin disorder is eczema(atopic dermatitis), rashes, warts, psoriasis, allergies, and acne, to name a few. to prevent the spread of many skin illnesses and protect the skin from harmful microorganisms. Without a doubt,hand washing is an essential safety precaution. The objective of this endeavor is to create and physically test a polyherbal hand wash utilizing easily accessible plants rather than a synthetic preparation. Hand sanitizer serves as an antibacterial in addition to hand washing with soap and water. There are several types of hand sanitizer, such as gel, foam, liquid solution, and others.Inactive chemicals and alcohol are the most commonly used substances in hand sanitizer[1] .

The goal of these antiseptic products is to stop the spread of eliminates 99 percent of the microorganisms on hands. Skin keeps more moisture and dries out less. Hygiene is the process of keeping oneself clean and is essential to maintaining one's health. Maintaining personal hygiene and using cleansers are crucial elements of a healthy lifestyle. These concepts highlight how crucial maintaining proper cleanliness is to avoiding disease[2]. Unfortunately, poor hand hygiene practices are still common because of a lack of scientific understanding, ignorance of the risks, and the unavailability of hand hygiene facilities, even though good and simple hygiene techniques are the most important, simple, and least expensive way to prevent health care associated (nosocomial) infections and the spread of antimicrobial multidrug resistance[3] .

Infections that arise or were caused by a high frequency of microorganisms in a hospital or other healthcare facility are known as nosocomial infections. compromised hosts, efficient means of transmission from one patient to another. Because of this, the number of nosocomial infections is shockingly increasing and has significantly increased in relation to hospital care outcomes, resulting in long hospital stays, high rates of disease and mortality, and excessive costs [4].

USES OF HERBAL HAND SANITIZER

Herbal hand sanitizers are used as an environmentally friendly and non-toxic option compared to chemical-based sanitizers. The following are the major uses:

1. **Prevention of Microbial Infections:** Herbal hand sanitizer is used to reduce or eliminate harmful microorganisms such as bacteria, viruses, and fungi present on the hands. It helps in preventing the spread of infectious diseases.
2. **Maintaining Hand Hygiene:** It is used as an effective alternative to soap and water, especially when washing facilities are not available. It ensures cleanliness of hands in daily activities.
3. **Skin-Friendly Application:** Due to the presence of natural ingredients such as Neem, Tulsi, and Aloe vera, it is used for gentle cleansing without causing dryness or irritation to the skin.

4. **Moisturizing Effect:** Herbal sanitizers are used to keep the skin hydrated and soft, as many herbal components possess moisturizing properties.
5. **Antimicrobial and Antiseptic Action:** It is used for its natural antimicrobial and antiseptic properties, which help in killing or inhibiting the growth of pathogens.
6. **Frequent Use Safety:** Herbal hand sanitizers are suitable for repeated use as they contain fewer harsh chemicals, making them safer for prolonged application.
7. **Use in Healthcare and Daily Life:** It is commonly used in hospitals, schools, homes, and public places to maintain hygiene and prevent contamination.
8. **Eco-friendly and Non-toxic Use:** Herbal hand sanitizers are used as an environmentally friendly and non-toxic option compared to chemical-based sanitizers.

BENEFITS OF HERBAL HAND SANITIZER

1. **Natural and Safe Composition:** Herbal hand sanitizer is formulated using natural ingredients such as Neem, Tulsi, and Aloe vera, which are considered safe and less harmful compared to synthetic chemicals.
2. **Effective Antimicrobial Activity:** It provides good protection against a wide range of microorganisms including bacteria, fungi, and some viruses due to the presence of bioactive phytochemicals.
3. **Skin-Friendly and Non-Irritating:** The formulation is gentle on the skin and reduces the chances of irritation, redness, or allergic reactions, making it suitable for all skin types.
4. **Moisturizing Property:** Herbal ingredients like Aloe vera help in maintaining skin hydration and prevent dryness, which is commonly observed with alcohol-based sanitizers.
5. **Reduced Side Effects:** It contains fewer harsh chemicals, thereby minimizing side effects such as skin dryness, cracking, or dermatitis.
6. **Pleasant Fragrance:** Herbal sanitizers possess a natural and mild fragrance, eliminating the need for artificial perfumes.

7. Eco-Friendly Nature: These sanitizers are biodegradable and environmentally friendly, causing less harm to the ecosystem.

8. Safe for Frequent Use: Herbal hand sanitizers can be used repeatedly without causing significant damage to the skin barrier.

9. Cost-Effective Preparation: Many herbal ingredients are easily available and economical, making the formulation cost-effective.

10. Additional Therapeutic Benefits: Some herbal components exhibit anti-inflammatory, antioxidant, and healing properties, which improve overall skin health.

MATERIALS & METHODS

The following Material were used for the preparation of the herbal hand sanitizer:

- Neem leaves (*Azadirachta indica*)
- Tulsi leaves (*Ocimum sanctum*)
- Aloe vera gel
- Ethanol (70%)
- Glycerin
- Lemon oil
- Distilled water

Table 1: Equipment and Requirement

Sr. No	Equipment/Apparatus	Use
1	Beakers and conical flask	Mixing, heating of extracts and formulations
2	Graduated cylinders	Measuring liquid ingredients
3	Digital weighing balance	Accurate weighing of materials
4	Stirring rod	Uniform mixing and dispersion
6	Sonicator (ultrasonic bath)	Extraction enhancement and uniform dispersion
7	Thermometer	Temperature monitoring during extraction

8	PH meter/Paper	Determination of formulation PH
9	Ostwald viscometer	Measurement of viscosity
10	Glass slides	Spreadability testing
11	Petri dishes and inoculation loop	Antibacterial testing
12	Incubator	Incubation of microbial cultures

DETAILS OF HERBAL INGREDIENTS

1. NEEM (*Azadirachta indica*)

Botanical Name: *Azadirachta indica*

Kingdom: Plantae

Family: Meliaceae

Part Used: Leaves

Chemical Constituents: Azadirachtin, Nimbin, Nimbidin, Quercetin, Flavonoids, Tannins

Uses: Neem exhibits strong antibacterial, antifungal, antiviral, and anti-inflammatory properties. It is widely used in skincare products and helps in reducing microbial load on the skin.



Fig 1: Neem (*Azadirachta indica*)

2. TULSI (*Ocimum sanctum*)

Botanical Name: *Ocimum sanctum*

Kingdom: Plantae

Family: Lamiaceae

Part Used: Leaves

Chemical Constituents: Eugenol, Ursolic acid, Rosmarinic acid, Linalol, Flavonoids

Uses: Tulsi possesses antimicrobial, antioxidant, and anti-inflammatory activities. It helps in inhibiting the growth of bacteria and enhances skin protection.



Fig 2: Tulsi (*Ocimum sanctum*)

3. ALOE VERA (*Aloe barbadensis* Miller)

Botanical Name: *Aloe barbadensis* Miller

Kingdom: Plantae

Family: Asphodelaceae

Part Used: Leaves (Gel)

Chemical Constituents: Aloin, Aloe-emodin, Saponins, Vitamins (A, C, E), Enzymes, Amino acids

Uses: Aloe vera is known for its moisturizing, soothing, wound-healing, and anti-inflammatory properties. It helps in preventing dryness and irritation caused by alcohol in sanitizers.



Fig 3: Aloe Vera (*Aloe barbadensis* Miller)

PROCEDURE

1. Extraction of Neem (*Azadirachta indica*)

Fresh neem leaves were collected and washed thoroughly with clean water to remove dust and impurities. The cleaned leaves were then dried under shade for 6–7 days, avoiding direct sunlight to preserve active constituents. After complete drying, the leaves were ground using a grinder or mortar and pestle to obtain a fine powder. About 10 g of neem leaf powder was weighed and transferred into a suitable container. To this, 100 ml of distilled water (or 70% ethanol) was added. The mixture was heated on a water bath at 60–70°C for

20–30 minutes without boiling. After heating, the mixture was allowed to cool at room temperature. Once cooled, the solution was filtered using muslin cloth or filter paper to remove solid residues. The clear filtrate obtained was collected as neem extract.

2.Extraction of Tulsi (*Ocimum sanctum*)

Fresh Tulsi leaves were collected and washed thoroughly with clean water to remove dust and impurities. The leaves were then dried under shade for 1–2 days to preserve their active constituents. After drying, the leaves were ground into a fine powder using a grinder or mortar and pestle. About 10 g of Tulsi leaf powder was weighed and transferred into a suitable container. To this, 100 ml of distilled water (or 70% ethanol) was added. The mixture was heated on a water bath at 60–70°C for 20–30 minutes without boiling. Then, it was allowed to cool to room temperature. The cooled mixture was filtered using muslin cloth or filter paper to remove solid particles. The filtrate obtained was collected as Tulsi extract and stored in a clean, properly labeled container for further use.

3.Aloe vera Gel (*Aloe barbadensis* Miller)

Fresh Aloe vera leaves were collected and washed thoroughly with clean water to remove dirt and impurities. The outer green layer of the leaves was carefully removed using a sterile knife. The inner transparent gel was scooped out using a clean spoon. The collected gel was homogenized using a blender to obtain a uniform consistency. The homogenized gel was filtered (if required) to remove any fibrous material. The final Aloe vera gel was collected and stored in a clean, airtight, and properly labeled container.

PREPARATION OF SANITIZER

- 1. Measurement of Ingredients:** All required ingredients such as neem extract, tulsi extract, aloe vera gel, carbopol 940, glycerin, ethanol, and distilled water were accurately measured as per the formulation.
- 2. Preparation of Carbopol Base:** Carbopol 940 was dispersed in a small quantity of distilled water with continuous stirring to avoid lump formation. The mixture was allowed to hydrate and swell properly.
- 3. Preparation of Herbal Base:** Neem extract, tulsi extract, and aloe vera gel were mixed together in a clean container under constant stirring to obtain a uniform herbal base.
- 4. Addition of Alcohol and Glycerin:** Ethanol was added slowly to the herbal mixture with continuous stirring to ensure proper mixing and antimicrobial activity. Glycerin was added as a moisturizing agent and mixed thoroughly.

5. **Incorporation of Carbopol Solution:** The previously prepared carbopol solution was incorporated into the above mixture with continuous stirring to form a gel-like consistency.

6. **pH Adjustment:** Triethanolamine (or suitable neutralizer) was added dropwise to adjust the pH and to obtain the desired viscosity of the sanitizer.

7. **Final Volume Adjustment:** The volume was made up to the required quantity using distilled water, and the formulation was mixed thoroughly to ensure uniformity.

8. **Filling and Storage:** The prepared herbal hand sanitizer was transferred into clean, airtight, and properly labeled containers for storage and further evaluation.

Table2: Formulation table for herbal hand sanitizer

Sr. No	Ingredients	Role	F1 (10ml)	F2 (30ml)	F3 (50ml)
1	Neem Extract	Antibacterial	1ml	3ml	5ml
2	Tulsi Extract	Antimicrobial	1ml	3ml	3ml
3	Aloe vera Gel	Moisturizer	1.5ml	4.5 ml	7.5ml
4	Carbopol 940	Gelling Agent	0.1g	0.3g	0.5g
5	Ethanol (70%)	Antimicrobial Agent	6ml	18ml	30ml
6	Glycerine	Humectant	0.3ml	0.9ml	1.5ml
7	Triethanolamine	PH Adjuster	q. s.	q. s.	q. s.

8	Lemon Oil	Fragrance	1 drop	2-3 drops	3-4 drops
9	Distilled Water	Vehicle	q. s. to 10 ml	q. s. to 30 ml	q. s. to 50ml



Figure 4: Formulated herbal hand sanitizer

EVALUATION OF HERBAL HAND SANITIZER

- 1. Physical Appearance:** The prepared herbal hand sanitizer was evaluated for its physical appearance. The formulation was observed for color, clarity, and texture.
- 2. Determination of pH:** The pH of the prepared sanitizer was determined using a digital pH meter. The pH was found to be in the range of 6.2 – 6.8, which is suitable for skin application. This indicates that the formulation is skin-friendly and non-irritant.
- 3. Viscosity:** Viscosity of the formulation was determined using a viscometer.
- 4. Spreadability:** The spreadability was determined using the glass slide method. A small amount of sanitizer was placed between two glass slides and pressed. The formulation spread easily and uniformly, indicating good spreadability.
- 5. Drying Time:** The drying time of the sanitizer was determined by applying a small quantity on the hand. The formulation dried within 20–30 seconds, which is considered ideal for hand sanitizers. It showed quick drying and non-sticky nature.

6. Skin Irritation Test (Patch Test): A small quantity of the sanitizer was applied on a sensitive area of the skin (inner wrist). The area was observed for redness, itching, or irritation. No irritation was observed, indicating that the formulation is safe for topical use.

7. Visual Stability: The prepared sanitizer was stored at room temperature and observed for a period of 21 days.

8. Antimicrobial Test: The antimicrobial activity of the sanitizer was evaluated using the agar well diffusion method. The sanitizer solution was prepared and introduced into wells on agar plates inoculated with bacterial strains. The plates were incubated at 37°C for 24 hours.

RESULTS AND DISCUSSION

1. Physical Appearance

All herbal hand sanitizer formulations exhibited acceptable sensory characteristics. Tulsi imparted a greenish-Yellow color along with a mild and pleasant aroma, while Lemon provided a refreshing citrus aroma. Aloe Vera improved the texture and smoothness of the formulations. Among all batches, the formulations containing a balanced proportion of herbal and citrus components demonstrated better overall acceptability.

Table 3: Physical properties of herbal hand sanitizer

Sr. No	Evaluation parameter	Observation
1.	Colour	Brownish Yellow
2.	Odour	Pleasant
3.	Texture	Smooth Consistency

2. Determination of pH

The pH values of the formulations ranged between 6.5 and 6.8, remaining within the dermatologically safe range of 5.5–7.0.

Table 4 : pH of Formulation

Sr. No.	Formulation	pH
1.	F1	6.5
2.	F2	6.3
3.	F3	6.8



Fig 5: PH of Sanitizer

3. Viscosity

The sanitizer showed moderate viscosity, which indicates that it is neither too thick nor too thin. The formulation was still able to be dispensed through the spray nozzle, though it produced a slightly coarse spray compared to low-viscosity formulations. This ensures easy application and proper spreading on the skin.

Table 5: Viscosity Result

Sr. No.	Formulation	Viscosity
1.	F1	180cp
2.	F2	150cp
3.	F3	120cp

4. Spreadability

The formulation exhibited spreadability in the range of 5–6.9 g·cm/sec, which ensured easy and uniform application on the skin.

Table 6: Spreadability of Formulation

Sr. No.	Formulation	Spredability
1.	F1	5.3
2.	F2	6.5
3.	F3	6.9

5. Drying Time

The formulation dried within 20–30 seconds, which is considered ideal for hand sanitizers. It showed quick drying and non-sticky nature.

Table 7: Drying Time of Formulation

Sr. No.	Formulation	Drying Time
1.	F1	15
2.	F2	20
3.	F3	18

6. Skin Irritation Test

The area was observed for redness, itching, or irritation. No irritation was observed, indicating that the formulation is safe for topical use.

7. Visual Stability

Formulation was found to be visually stable under different storage conditions.

Table 8: Conditions of herbal hand sanitizer

Sr. No.	Conditions	Temperature	Colour change	Odour change	PH stability	Phase separation
1.	Room temperature	25°C ±2°C	No change	No change	Stable	None
2.	Refrigerated	4°C	No change	No change	Stable	None
3.	Elevated temperature	40°C ±2°C	No Change	Slightly odour change	Slightly decreased	None

8. Anti -microbial Test

After incubation, zones of inhibition were observed around the wells, indicating that the sanitizer possesses good antimicrobial activity.



Fig 6: Zone of Inhibition

DISCUSSION AND SUMMARY

The formulated herbal hand sanitizer showed satisfactory results in terms of physical properties, antimicrobial activity, and stability. The formulation exhibited good clarity, smooth texture, and a pleasant odor, making it suitable for regular use. The pH was found to be within the acceptable skin-friendly range, indicating that the formulation is safe for topical application without causing irritation. The antimicrobial activity of the formulation can be attributed to the presence of herbal ingredients such as tulsi (*Ocimum*

sanctum), which contains bioactive compounds like eugenol and flavonoids. These compounds are known for their antibacterial and antifungal properties, thereby helping in inhibiting the growth of microorganisms. Aloe vera was incorporated in the formulation due to its moisturizing, soothing, and healing properties. It contains compounds such as aloin and polysaccharides, which help in reducing skin dryness and irritation caused by alcohol-based sanitizers. Additionally, aloe vera improves skin hydration and provides a cooling effect. Alcohol acts as the primary antimicrobial agent in the formulation due to its rapid action against a wide range of microorganisms. However, frequent use of alcohol can lead to skin dryness and irritation by removing natural skin lipids. To overcome this limitation, glycerin was added as a humectant. Glycerin helps in retaining moisture in the skin and prevents excessive dryness, thereby improving skin compatibility and user comfort. The stability studies indicated that the formulation remained stable under different storage conditions, with no significant changes in color, pH, or phase separation. The antimicrobial studies showed effective inhibition of microbial growth, confirming the combined effect of herbal extracts and alcohol. Overall, the study demonstrates that the combination of tulsi for antimicrobial activity, aloe vera for soothing and moisturizing effect, and glycerin for hydration results in an effective, safe, and user-friendly herbal hand sanitizer.

CONCLUSION

The present study concluded that the herbal hand sanitizer formulated by us containing neem, tulsi, and aloe vera was successfully prepared and evaluated. Our formulation exhibited good physical properties such as color, consistency, and spreadability, along with a suitable pH that is compatible with skin. It showed satisfactory antimicrobial activity against common pathogens, indicating its effectiveness in maintaining hand hygiene. The formulation was also found to be safe for skin, as no irritation was observed during testing, and it provided a moisturizing and soothing effect due to the presence of aloe vera. Stability studies indicated that the formulation remained stable under different storage conditions. Overall, our prepared herbal hand sanitizer is effective, safe, stable, and skin-friendly, and it can be used as a natural and eco-friendly alternative to conventional synthetic sanitizers for regular use.

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