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Formulation and Evaluation of Herbal Hand Sanitizer

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Abstract: *The growing threat of infectious illnesses has heightened the necessity for hand hygiene products. However, the frequent use of chemical-based sanitizers often results in skin problems and irritation. Microbes and diseases are first spread through the hands. A crucial idea and practice in the prevention, management, and decrease of diseases is hand cleanliness. The herbal hand sanitizers have emerged as a safe and effective alternative to chemical-based sanitizers. This study aims to develop and evaluate a herbal hand sanitizer using natural ingredients such as Neem (Azadirachta indica), Tulsi (Ocimum sanctum), Aloe vera (Aloe barbadensis), Turmeric (Curcuma longa), and Orange essential oil to provide effective antimicrobial action while maintaining skin health. The herbal ingredients produce the antibacterial effect. The use of herbal extracts in hand sanitizers not only provides antimicrobial activity but also offers additional benefits such as moisturization and skin conditioning. Furthermore, herbal hand sanitizers are eco-friendly and sustainable, making them a preferable choice for environmentally conscious consumers.*

Keywords: infectious

I. INTRODUCTION

The sanitizers play very important role in the hand cleanliness. The chemical based sanitizers put a hazardous effect on the skin. Conventional sanitizers with chemical content are effective but frequently cause skin dryness, irritation, or allergies with regular use. This has led to increased interest in developing natural, plant-based sanitizers with antimicrobial properties and minimal side effects. So, the use of the herbal hand sanitizers become important. Herbal hand sanitizers serve as a preferable substitute for chemical ones. They contain the anti-bacterial and anti-microbial herbs like neem, tulsi also the moisturizing agents such as aloe vera, glycerine, coconut oil. Essential oils contribute both to fragrance and added therapeutic properties. The herbal hand sanitizers may be a cost-effective alternative to chemical based hand sanitizers, it is important to note that they may not be as effective in killing bacteria and viruses as alcohol based hand sanitizers recommended by health organizations. Additionally, it is important to ensure that the ingredients used in homemade hand sanitizers are safe and not harmful to the skin. The WHO has published some guidelines for the preparation of alcohol based sanitizers that it should contain at least 70% alcohol. It is important to follow proper hygiene practices and ensure that the equipment used is clean and sanitized. However, it is always best to use commercially available hand sanitizers that have been tested and approved by health organizations to ensure maximum effectiveness in preventing the spread of infectious diseases. Overall, the use of herbal hand sanitizers can help promote hand hygiene while also addressing concerns related to the overuse of chemical sanitizers.

AIM: Formulation and Evaluation of Herbal Hand Sanitizer

OBJECTIVE:

- To formulate and evaluate a herbal hand sanitizer using natural ingredients with antimicrobial properties to ensure effective hand hygiene and safety.
- To identify and select suitable herbal extracts (e.g., Neem, Tulsi, Aloe vera, Tea Tree oil) known for their antimicrobial, antiviral, and soothing properties.
- To formulate an alcohol-based and/or water-based hand sanitizer incorporating the selected herbal ingredients.

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- To evaluate the physicochemical properties of the formulation, including pH, viscosity, color, clarity, and odor.
- To assess the antimicrobial efficacy of the herbal hand sanitizer against common pathogens (e.g., E. coli, Staphylococcus aureus).
- To perform stability studies under various conditions to determine shelf-life and product integrity over time.

II. MATERIALS AND METHODS

Sr.No	Materials
1	Neem leaves (Azadirachta indica)
2	Tulsi leaves (Ocimum sanctum)
3	Aloe vera gel (Aloe barbadensis)
4	Turmeric Extract (Curcuma longa)
5	Orange essential oil
6	Ethanol (60%)
7	Glycerine
8	Distilled water

Figure no. 01: Image of Aloe Vera, Neem, Tulsi, Turmeric and Orange essential Oil

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EXTRACTION OF HERBAL INGREDIENTS:

Neem Extract: 5g Neem powder was macerated with 20 mL ethanol at 100°C for 5–10 minutes, filtered.

Tulsi Extract: 1g Tulsi powder extracted with 10 mL ethanol at 80–100°C for 5–10 minutes, filtered.

Fig No 02 : Extract of Neem

Fig No : 03 Extract of Tulsi

FORMULATION TABLE

Sr. no.	Ingredient	Quantity (per 100 mL)	Function
1.	Neem Extract	5 mL	Antibacterial, Antifungal
2.	Tulsi Extract	5 mL	Antiviral
3.	Aloe Vera	10 mL	Moisturizer, Soothing agent
4.	Turmeric Extracts	2 mL	Antimicrobial
5.	Orange Essential Oil	2 mL	Antiseptic, Fragrance
6.	Ethanol (70%)	70 mL	Antimicrobial Agent
7.	Glycerine	5 mL	Moisturizer, Skin Protector
8.	Distilled Water	q.s. to 100 mL	Vehicle

Table No 01: Formulation Table

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Preparation Method:

1. Herbal extracts were prepared separately.
2. Ethanol and herbal extracts were mixed gradually.
3. Aloe vera gel and glycerine were added.
4. Orange essential oil was incorporated.
5. The final volume was adjusted with distilled water.
6. The mixture was homogenized, and pH was adjusted between 5.5–
7. The formulation was packed in sterile containers.

EVALUATION

Organoleptic Test:

The gels were reported to be homogeneous, transparent, and easy to use with a light and continuous flow. They did not exhibit any syneresis (separation of liquid from a gel-like substance), which is a positive attribute. However, the gels developed a bubble-like appearance with overnight storage, which is a common occurrence in gels and is generally not considered a major issue. The bubbles disappeared after a light shake, indicating that the gels were able to maintain their homogeneity and flowability.

The color of the gel was reported as yellowish-white, which could be due to the presence of certain active ingredients or additives used in the formulation. The odour was described as characteristic, which could be an indication of the presence of specific fragrances or natural extracts used to enhance the product's essence.

Overall, based on the organoleptic test results, it appears that the developed hand sanitizer gels had the desired physical attributes and would likely be well-received by consumers. However, it is important to note that the effectiveness of the sanitizer in killing or inhibiting the growth of harmful microorganisms cannot be determined based solely on organoleptic tests and requires further testing and validation.

S.No.	Evaluation parameter	observation
1	Colour	Slightly yellowish
2	Odour	Mild
3	pH	6.5 ± 0.1
4	Clarity testing	Opaque
5	Skin irritation test	No irritation observed

Table No 02: Organoleptic Test

pH Evaluation:

The pH values of the hand sanitizer gel formulations were measured using a digital pH meter. The aim of the study was to evaluate how various manufactured formulations were neutralized, which likely refers to the process of adjusting the pH of the formulation to a desired level.

The ideal pH range for a topical dose form, such as a hand sanitizer gel, should be within the skin's natural pH range of 4.0 to 7.0 to prevent skin irritation and inflammation. The pH measurements obtained in this study were reported to average around 4.3, which is fairly acidic and falls within the lower end of the skin's natural pH range.

The presence of a significant amount of aloe vera in the formulation, which naturally has an acidic pH of 4.0 to 4.5, could potentially be the cause of the lower pH measurements. However, it is important to note that other ingredients in the formulation could also contribute to the pH level.

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Fig No 04: Digital ph Meter

Viscosity:

The viscosity of hand sanitizer gel formulations is an important aspect that affects their consistency and flowability when applied to the skin. A higher viscosity can result in a thicker and more gellike consistency, which may be preferred by some users. the viscosity of the generated gel formulations was measured in this study, and the effects of gel components were examined. The results indicated that the produced formulations had higher viscosities compared to pure ethanol and water. This suggests that the gel components, such as thickeners or gelling agents, were effective in increasing the viscosity of the formulations.

It is important to note that the viscosity of the gel formulations can also be influenced by factors such as temperature, shear rate, and formulation composition. Therefore, it is essential to carefully select and control the gel components to achieve the desired viscosity and consistency for the hand sanitizer gel formulation.

Spreadability Study:

Spreadability is an important factor to consider when developing hand sanitizer formulations, as it can affect both customer compliance and the effectiveness of the product. A hand sanitizer gel with poor spreadability may not be applied evenly, which can result in areas of the skin being missed and potentially leaving areas of the skin unprotected.

To test the spreadability of the hand sanitizer gel formulations, a gel spreadability test was conducted in this study. The test measures the time it takes for the gel to spread over a surface and the force required for spreading. The optimum gel formulation should have a quicker spreading time and require less force to spread (i.e., high spreadability).

Stability:

The stability trials involved 4 weeks of storage at various temperatures, including 40°C, 25°C, and 37°C. The prepared hand sanitizer showed no phase separation or colour change throughout the stability testing.

Physicochemical Properties	
Appearance	Yellowish-white, clear gel
Odor	Aromatic and characteristic
Feel	Smooth and non-sticky
pH Measurement	pH ranged between 5.5 to 7, ensuring skin compatibility
Viscosity Test	Suitable viscosity was achieved ensuring ease of application and non-dripping consistency
Spreadability Test	High spreadability confirmed easy and even application
Ethanol Content	Ethanol concentration was found to be between 40–50%, slightly lower than desired standards (>60%)

Fig No 05: Evaluation Tests and Herbal hand sanitizer

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III. RESULT AND DISCUSSION

Organoleptic Test:

To assess how the created formulations looked physically, an organoleptic test of hand sanitizer gels was performed. The created hand sanitizer gels underwent a visual quality examination, and the findings showed that the tested formulation had satisfactory qualities. The gels were uniform, transparent, and had the expected smell. There was no syneresis, and they were simple to use, light to spread, and had a steady flow.

With overnight storage, a bubble-like look developed, but it vanished after a gentle shaking.

Sr No	Evaluation Parameter	Observation
1	Colour	Slightly Yellowish
2	Odour	Characteristic
3	Clarity testing	Opaque
4	Appeareance	Bubble like

Table No 03: Organoleptic Test Results

pH Evaluation:

A digital pH metre was used to measure the pH levels of the hand sanitizer gel formulations. The objective of the study was to examine the neutralization of various produced formulations. To prevent skin irritation and inflammation, the optimal requirements for a topical dosage form's pH value should be within the skin's natural pH range, which is 4.0 to 7.0. The produced compositions' pH readings were somewhat acidic, averaging approximately 4.3. This might be as a result of the substantial amount of aloe vera, which naturally has an acidic pH (4.0–4.5).

Viscosity (Rheological Properties):

One of the key variables that should be under control is the viscosity of the created gel formulations since it might indicate the consistency and flowability of the gel formulations when applied to the skin. The TCV 300 viscometer was used in this study's viscosity test to measure preparation thickness and investigate the impact of gel components on the rheological qualities of the end products. The viscosities of prepared formulations were greater than those of ethanol and water (0.9 cP). The prepared formulation's viscosity was determined to be 0.4 cp.

Spreadability Study:

Spreadability is very important when applying hand sanitizers because it affects customer compliance and the uniformity of the applied gels to fulfill the requirements for topical application quality. To determine if the manufactured hand gels could adequately disseminate when applied to the skin, the gel spreadability test was performed; the ideal gel formulation should have a shorter spreading time (i.e., high spreadability). The formulation's viscosity is one of the key factors that might impact the gel's spreadability; a lower viscous gel has a higher spreadability. The created hand sanitizer gels spreadability values, which are discovered to be 532 percent.

Test Performed	Result
pH Measurement	4.3
Viscosity	0.4cp
Spreadability	High Spreadability

Table No 04: Results

V. CONCLUSION

The present study successfully led to the formulation and evaluation of a herbal hand sanitizer using natural ingredients such as *Neem (Azadirachta indica)*, *Tulsi (Ocimum sanctum)*, and *Aloe vera*, which are well known for their antimicrobial, antioxidant, and soothing properties. The formulated sanitizer showed significant antimicrobial activity

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against common skin pathogens, including *E. coli* and *Staphylococcus aureus*, thereby demonstrating its effectiveness in reducing microbial load on the hands.

Physicochemical evaluations such as pH (which remained within the skin-friendly range), viscosity, and spreadability confirmed the product's suitability for topical application. Stability studies under various storage conditions indicated that the formulation remained stable in terms of appearance, fragrance, and efficacy over time.

Additionally, the formulation was found to be non-irritating and left the skin moisturized, addressing the common drawback of alcohol-based sanitizers that often cause dryness and irritation. The use of herbal ingredients also ensures a safer, eco-friendly, and cost-effective alternative with fewer side effects compared to synthetic formulations.

In conclusion, the herbal hand sanitizer formulated in this study is not only effective in maintaining hand hygiene but also promotes skin health, making it a viable option for regular and prolonged use in both healthcare and daily environments. Further clinical studies and consumer acceptability tests may help in scaling up for commercial production.

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