WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 14, Issue 10, 272-285. Review Article ISSN 2277–7105

HERBAL ALTERNATIVES TO CHEMICAL HAND SANITIZERS: A REVIEW OF THEIR EFFECTIVENESS AND BENEFITS

Adnan Siddiqui*, Sarita Nulkar, Shubham Patil, Swaraj Patil, Samruddhi Sawant and Parvez Mulla

Department of Pharmaceutics, Yashwant Redekar College of Pharmacy, Nesari.

Article Received on
28 March 2025,

Revised on 18 April 2025,
Accepted on 08 May 2025

DOI: 10.20959/wjpr202510-36649

***Corresponding Author**
Adnan Siddiqui
Department of Pharmaceutics, Yashwant Redekar College of Pharmacy, Nesari.

ABSTRACT

The main objective of this present review is to explore the preparation, evaluation, and effectiveness of herbal alternatives to chemical hand sanitizers, focusing on their safety, efficacy, and quality. Herbal hand sanitizers are natural antimicrobial products that is use to eliminate harmful microorganisms while maintaining skin health. These formulations aim to provide a safer, skin-friendly alternative to alcohol-based and chemical sanitizers, which can cause dryness, irritation, and allergic reactions. Herbal active ingredients commonly used include neem, tulsi, aloe vera, peppermint, clove, and Guava. These natural agents exhibit antibacterial, antiviral, and antifungal properties. Evaluation parameters discuss in this review include pH level, viscosity, skin irritation potential, and evaporation rate and user acceptability. This article highlights recent innovations and future prospects of herbal sanitizers in maintaining hygiene without compromising skin integrity. The benefits of herbal sanitizers include minimal side effects, reduce allergic responses, and the absence of harsh chemicals.

KEYWORDS: Herbal sanitizer, Antibacterial, Natural hygiene, Antiviral herbs.

1. INTRODUCTION

Hygiene is define as maintenance of cleanliness practices which carries importance in maintenance of health. Keeping body hygiene and usage of cleansers are must for healthy living.[1] Skin is the most expose part of the body to the environmental pollution and it give protection towards harmful bacteria.[3] Hands are main source of transmission of infections and microbes so hand hygiene and personal hygiene is important factor to prevent spread of

disease.[4] During the global pandemic, the WHO (World Health Organization) suggest proper hand hygiene is important key factor to prevent spread of all infection. The most common skin problems are eczema (atopic dermatitis), warts, acne, psoriasis, rashes, allergic reaction etc. To protect the skin from harmful micro-organisms and to prevent spreading of many pores and skin infection. Hand cleaning is certainly a vital precaution. Hand sanitizers are one of the most commonly used hygienic products to prevent and remove germs, viruses and bacteria in our body, especially in our hands.[3] Hand sanitizer is significant step in controlling the infectious virus in health care. Hand sanitizer is also called as hand antiseptic or hand rub. There are several forms of sanitizer available in market like gel, foam and liquid solution.[3] When the soap and hand wash are not available hand sanitizer use is recommended.[2] In comparison to soap, hand sanitizer is far more effective in killing microorganism and doesn't cause as much hand drying.[3]

Before the invention of modern medicine, plants were the main remedy for testing various disease. With the arrival of different antibiotics, bacteria also develop resistance to these substances. These leads researcher's importance towards the plants having antibacterial properties. They work to establish the unique ability of different metabolites to exhibit stable and long-lasting activity against a wide range of diseases.[4]

Thus, in this report study, we use tulsi, aleo vera, peppermint, clove, neem and guava leave extract to develop a hand sanitizer due to its beneficial effect against pathogenic bacteria.[4]

2. Herbal medicine

The World Health Organization (WHO) defines herbal medicine as a practice which includes herbs, herbal materials, herbal preparations and finished herbal products, that contain as active ingredients parts of plants, or other plant materials, or combinations.[5] These herbs are derived from plant parts such as leaves, stems, flowers, roots, and seeds.[6] Herbal drugs contain active ingredients, plant parts or plant materials in the processed or crude state with certain excipients, i.e., dilutions, solvents or preservatives.[6,7] These active ingredients protect plants from damage and diseases and contribute to the plant aroma, flavor and color. Scientifically, they are known as phytochemicals which include several classes such as saponins, flavonoids, glycosides, tannins, alkaloids and terpenoids.[8] Phytochemicals have been scientifically validated over the years to provide health benefits for humans.[9] For ex. herbal remedies used as sedative and stomachic mixtures contain mainly aromatic plant species which have therapeutic essential oils, possessing antibacterial, stomach-soothing and

antispasmodic properties. Plant species which have a high tannin content are used in mixtures for diarrhea and stomach ulcers; generally showing antimicrobials, astringents and anti-inflammatory. Activities.[10,11] Bioactive and disease preventing phytochemicals present in medicinal plants are shown in table no.01.

Table No. 01: Phytochemical constituents of medicinal plants.

class	Characteristic	Use	macological activity
Alkaloids	Organic nitrogenous bases, bitter taste, colorless/yellow, crystalline solids, liquids	Biosynthesis of pharmaceuticals	Anticancer, antimicrobial, amoebicidal, anti-inflammatory,
Saponins	Soap-like forming property, bitter taste,	Detergent, wetting and emulsifying agent	Antifeedant, antifungal, antiobesity, antioxidant
Tannins	Water-soluble, leather hides,	Used for cationic dyes, production of ink,	Antimutagens, anticarcinogens, antimicrobial,
Flavonoids	Free radical scavenger	Prevents microbial infection,	Anti-inflammatory, antimicrobial, antibacterial, antioxidant

Chemicals in Medicines[12]

One of Chemistry's most significant contributions is in the field of medicine. Chemicals are used to create medicines. Chemical analysis and the synthesis of novel chemicals are used to create new medications. This topic is so wide that it has spawned a new branch of chemistry known as 'Medicinal Chemistry' of 'Chemical in Medicines Medicinal chemistry is a branch of chemistry concerned with the design, analysis, development, and synthesis of drugs as medicine. Medicines are chemical compounds that help living creatures in the treatment of diseases or the relief of suffering. This discipline necessitates knowledge in synthetic organic chemistry, pharmacology, and biological sciences. Medicines include numerous compounds. Let's study everything there is to know about Chemicals in Medicines in this post. Scroll down to find more.

Introduction to Chemicals in Medicines

Drugs are chemical compounds of low molecular masses that interact with macromolecular targets and produce suitable biological responses. When drugs are taken in the prescribe manner to cure, prevent or diagnose a particular disease or ailment, it is known as medicine. However, it can become poisonous if consumed in higher doses than recommend. Chemicals are modified to create antiseptic and disinfectant drugs also.

Chemicals in Medicines[12]

1. Antacids
2. Antihistamines
3. Tranquillizers and Analgesics
4. Antimicrobials
5. Antibiotics
6. Antiseptics and Disinfectants
7. Antimicrobials

Why Herbal Ingredients in Hand Sanitizer Formulations

The integration of herbal ingredients into hand sanitizer formulations has gained significant attention due to their natural antimicrobial properties, skin-friendliness, and consumer appeal. Medicinal plants such as Ocimum sanctum (Tulsi) Aloe vera, and tea tree oil have demonstrated antibacterial, antiviral, and antifungal activities, making them effective alternatives or complements to synthetic agents like alcohol. Unlike chemical sanitizers, herbal components often offer additional benefits such as moisturization, reduced skin irritation, and antioxidant activity. Moreover, growing consumer preference for eco-friendly and natural products has fueled the demand for herbal-based hygiene solutions. This trend aligns with sustainable and traditional medicinal practices, promoting the development of safe, effective, and biodegradable hand sanitizers. As a result, the inclusion of herbal ingredients represents a promising approach to enhance both the efficacy and acceptability of hand hygiene products.

Ideal characteristics of herbal hand sanitizer

- ✓ Kills 99.99% of germs: Effective against a broad spectrum of microorganisms, including bacteria, viruses, and fungi.
- ✓ Quick action Rapidly kills germs, ideally within 15-30 seconds.
- ✓ Non-toxic and non-irritating: Gentle on skin, minimizing the risk of allergic reactions or irritation.
- ✓ Hypoallergenic Suitable for sensitive skin, reducing the likelihood of adverse reactions.
- ✓ Portable and compact Easy to carry in pockets, purses, or bags.
- ✓ Easy to apply Simple, intuitive dispensing mechanism.
- ✓ Dermatologist-testing: Ensures safety and efficacy for sensitive skin.
- ✓ Environmentally friendly packaging: Eco-friendly materials and minimal waste.

Advantages of herbal hand sanitizer[13]

- Saves time Hand sanitizer is faster than washing hands with soap and water.
- Moisturizing properties Many hand sanitizers contain emollients or humectants to help maintain skin hydration.
- Affordable: Hand sanitizer is generally inexpensive and widely available.
- Accessible: Can be used anywhere, anytime, without requiring access to soap and water.
- Easy to carry: Hand sanitizer is lightweight and portable, making it easy to take on-the-go.
- Quick application: Fast and simple to apply, requiring no water or towels.
- Customizable: Herbal hand sanitizers can be customized to suit individual skin types and preferences.
- Free from harsh chemicals and artificial fragrances. Environmentally friendly and biodegradable.

Disadvantages of herbal hand sanitizer[16]

- Variable efficacy: The effectiveness of herbal hand sanitizers can vary depending on the type and quality of herbal ingredients used.
- Limited antimicrobial spectrum: Herbal hand sanitizers may not be effective against all types of microorganisms, such as norovirus or Clostridioides difficile.
- Shorter shelf life: Herbal hand sanitizers may have a shorter shelf life due to the natural ingredients used, which can degrade over time.
- Skin irritation: Some herbal ingredients can cause skin irritation, such as allergic reactions or contact dermatitis.
- Interactions with medications: Certain herbal ingredients can interact with medications, such as blood thinners or diabetes medications.
- Lack of standardization: Herbal hand sanitizers may not be standardized, which can lead to inconsistent quality and efficacy.

Application of herbal hand sanitizer

- Can be used as a natural alternative to alcohol-based sanitizers.
- Helps in preventing infections caused by bacteria and viruses.
- Gentle on the skin, reducing dryness and irritation.
- Suitable for healthcare professionals to maintain hygiene.
- Reduces the risk of cross-contamination.

- Can be used in public transport, malls, and workplaces for quick disinfection.
- Portable and eco-friendly alternative for travelers.

Composition of herbal hand sanitizer

- ✓ **Antimicrobial** – Antimicrobial refers to any substance that kills or inhibits the growth of microorganisms such as bacteria, viruses, fungi, or protozoans. These agents can be natural or synthetic and are used in various products to prevent the spread of infections and reduce microbial contamination. (e.g., Tulsi and guava)
- ✓ **Thickening agent-** A thickening agent is a substance added to a liquid to increase its viscosity without substantially changing its other properties. This helps create a more consistent texture and can improve the stability and appearance of products, such as gels, creams, and sauces. Common examples include xanthan gum, carbomer.
- ✓ **Emulsifier-** An emulsifier is a substance that helps mix two liquids that normally do not blend well, such as oil and water. It stabilizes emulsions by reducing the surface tension between the two liquids, preventing them from separating. Emulsifiers are commonly used in food (e.g., polysorbate 20), cosmetics, and pharmaceuticals.
- ✓ **Color's, Perfumes and Preservatives-** A preservative prevent or inhibits microbial growth and extends the shelf life of various products, including pharmaceutical drugs, cosmetic products, biological products. (e.g., Methyl paraben, Propyl paraben.

Benefits of herbal hand sanitizer[15]

- Portable and easy to carry around
- Easy and more convenient way of cleansing the hand,
- Takes less time to clean than hand washing
- Quickly deactivates and kills microorganism on the skin
- Leaves a soothing, fresh feelings on the hands
- Better option if there is a lack of water if there are large crowds

Herbs

Some herbal ingredients which are uses in the preparation of herbal hand sanitizer.

1) TULSI[14]

- **Synonym:** Ocimum tenuiflorum
- **Biological Source:** Tulsi consists of the fresh and dried leaves of Ocimum species like Ocimum sanctum L. and Ocimum basilicum L.

- **Family:** Lamiaceae.
- **Uses**

1. Anti-inflammatory
2. Blood purifier
3. Anti-pyretic
4. Anti-fungal
5. Anti-bacterial

Fig. No. 01: Tulsi leaves.

2) GUAVA[15]

- **Synonym:** psidium guajava
- **Biological source:** Guava leaves contain fresh and dried leaves of Psidium guajavaitcontains flavonoid, alkaloid and tannin molecules.
- **Chemical constituents:** Guava leaves contain tannin, flavonoids
- **Family:** Myrtaceae.
- **Uses**

1. Reduce cholesterol
2. Good for diabetes
3. Anticancer properties
4. Antibacterial properties help with asthma
5. Protect Gastric system
6. Help with depression

Fig. No. 02: Guava leaves.

3) NEEM[17]

- **Synonym:** Azadirachta indica
- **Biological source:** Dried leaves of Azardirachtaindica
- **Chemical constituents:** The active ingredents are Azadriachtin, Salannin and Meliacin.
- **Family:** Miliaceae
- **Uses:** Prevent the dryness of hairs and flaking of hair.

Fig. No.03: Neem.

4) ALOE VERA[17]

- **Synonym:** Aloe barbadensis Mill.
- **Biological source:** Aloe**,** Aloe barbadensis, Aloe perryi, Aloe Ferox is the dried fruit juice obtained from the leaves of Aloe spicata.
- **Chemical constituents:** Aminoacids, Steroid, Anthraquinones, Saponin.
- **Family:** Liliaceae.
- **Uses:** Calming the scalp and itching deep cleansing of oily hair have strength.

Fig. No. 04: Aloe vera.

5) PEPPERMINT[17]

- **Synonym:** Mentha Piperita**.**
- **Biological source:** It Is the Oil Obtained by The Distillation of Mentha Piperita.
- **Chemical constituents:** It Contains Menthol, Along with A Methyl Acetate, Isovalerate, Menthone.
- **Family:** Lamiaceae
- **Uses**: Stimulant, Stomachic, Carminative & Colic.

Fig. No. 05: Peppermint.

6) CLOVE[17]

- **Synonym:** Syzygium Aromaticum
- **Biological Source:** Clove Essential Oil Is Extracted from Eugenia Caryophyllata (Also Known as Syzygium Aromaticum, Eugenia Aromatica, E. Carophyllus)
- **Family:** Myrtaceae.
- **Chemical Composition:** Eugenol, Eugenol, Acetate, Iso-Eugenol and Caryophyllene.
- **Uses:** Clove Oil Can Be Used for Acne, Bruises, Burns and Cuts, Keeping Infection at Bay and as a Pain Reliever.

Fig. No. 6: Clove.

Evaluation Parameters

1. Organoleptic properties

Test like color and clarity were carried out.[3]

2. Physical properties

a) pH: Using digital pH meter, the pH of hand sanitizer formulation was evaluating. In 100ml of distilled water, 1gm of gel was disperse then left to stand for 2hr. and then reading was note .[3]

b) Irritancy test: two healthy volunteers were select the hand sanitizer applying on palm and time was note. Irritancy, redness, dryness and itching were checking.[3]

c) Evaporation rate: two volunteers were select. The hand sanitizer was applying on their palm while rubbing the sanitizer on palm evaporation took place and that time was noting evaporation rate was below 1min.[3]

d) Spreadability test: The spreadability test of an alcohol base hand sanitizer was test by using laboratory made device with two glass slides.[3]

The spreadability test of hand sanitizer was calculating by using formula.

$$S = M \times L/T \text{ (gram cm/sec)}$$

Where,

M = weight of upper slide L = length of glass slide

T = time taken to separate the slides for F1-m=0.5, l=2.5, t=1min

for F2- m=0.5, l=4.5, t= 1min for F3- m=0.5, l=4.5, t= 1 min

e) Viscosity: Using a brook field viscometer, the viscosity of an alcohol-based hand sanitizer composition is assess at 37°C. For determining viscosity, a Brook field viscometer

connected to a T-bar spindle (S-94) had been utilize. A 10ml beaker containing 5gm of solution was filling, and the spindle was then lower perpendicularly while being careful to keep the spindle away from the beaker's bottom. To produce a torque larger than 50%, the spindle was turning at speeds of 50 rpm, 60 seconds after the measurement was taken, measurements were taken.[3]

f) Antimicrobial test: The screening of anti-microbial efficacy of the formulated hand sanitizer has done by aseptically performing on Escherichia coli by using agar well disk diffusion technique. a well was prepare in the plates (containing 15ml agar media) with the help of cork-borer. For this agar well diffusion technique, the nutrient agar medium was use as a culture media.[3]

Composition of Agar media

Table No. 03: Composition of Agar media.[17]

Sr.no	Ingredient	Quantity
1	Agar	1 gm
2	Peptone	0.5 gm
3	Beef extract	0.5 gm
4	NaCl	0.25gm
5	Water	50 ml

To perform antibacterial test, the pre-sterilized petri plate is use. To pre sterilize, the petri plate was incubate for 24 hrs at 37˚C. Then next to this, the agar culture media was poured in the petri plate uniformly in aseptic condition. After spreading, the agar medium was cover with another petri plate and kept aside for 24 hrs in incubator to solidify the agar medium. After this, the plate is removed and on these plates the well is form. On the plates, the solution which contains bacterial strains i.e. E. coli where uniformly spread in aseptic condition. Now, in which the well was formed on petri plates, 0.5ml & 1ml formulated hand sanitizer was add in aseptic condition by the pipette. Then these two plates were kept for incubation for 24 hrs 37˚C. After the incubation period, the zone of inhibition was found on the petri plate. The zone of inhibition of hand sanitizer was measure in cm by scale.[4]

Future prospective of herbal hand sanitizer

The future prospects of herbal hand sanitizers look promising due to increasing consumer awareness about **natural, chemical-free products, rising demand for sustainable and eco-friendly hygiene solutions, and growing concerns over antibiotic resistance caused by synthetic sanitizers.**

Here are some key trends and opportunities.

1. Rising Demand for Natural & Organic Products

Consumers are shifting from alcohol-based sanitizers (which can cause skin irritation) to **plant- based, herbal sanitizers** with antimicrobial properties (e.g., aloe vera, neem, tulsi, turmeric, tea tree oil). Preference for **non-toxic, non-drying formulations** that are safe for children and sensitive skin.

2. Growing Awareness of Antimicrobial Resistance (AMR)

Overuse of synthetic sanitizers (like triclosan) contributes to **superbugs. Herbal** sanitizers with **natural antimicrobial agents** (e.g., eucalyptus, clove, cinnamon oil) are seen as a safer alternative.

3. Eco-Friendly & Sustainable Formulations

Biodegradable and **alcohol-free herbal sanitizers** are gaining traction among environmentally conscious consumers. Brands are focusing on **plastic-free packaging** (e.g., bamboo containers, refillable bottles).

4. Innovation in Product Development

Nano-herbal sanitizers (using nanotechnology for better efficacy).

Gel, spray, and foam variants with added moisturizers (like aloe vera and coconut oil).

Essential oil-infused sanitizers for aromatherapy benefits.

CONCLUSION

Nowadays, people are facing various skin-related issues such as dryness, irritation, and allergic reactions due to the frequent use of chemical-based hand sanitizers. These sanitizers often contain high levels of alcohol and synthetic chemicals which can damage the skin barrier and cause long-term side effects. In comparison, herbal hand sanitizers are a better and safer alternative, as they are made from natural ingredients with antimicrobial properties and minimal side effects. The main purpose behind this review was to highlight the effectiveness and safety of herbal-based hand sanitizers as a natural substitute for chemical formulations. By incorporating plant-based extracts with known antibacterial and antiviral activities, we can reduce the harmful impact on skin health while still ensuring proper hygiene. Herbal hand sanitizers are a more skin-friendly and sustainable option in maintaining hand hygiene. Herbal Hand sanitizer is more safe than synthetic Hand sanitizer.

ACKNOWLEDGEMENT

Sincere thanks to Principal my guide and management of Yashwant Redekar College of Pharmacy, Nesari, India. for providing necessary facilities throughout this study.

REFERENCES

1. Nandkishor S. Wani, Ashish K. Bhalerao, Vikram P. Ranaware, Rahul Zanje, formulation evaluation of hand sanitizer, international journal of pharmatech research, Jan-Mar 2013.
2. Dyah Rahmasari, Esti Hendradi, Uswatun Chasanah, Formulation and evaluation of hand sanitizer gel containing infused of binahong leaf (Anredra cordifolia) as antibacterial prepration, Farmasains, doi 10.22219, published on august 6, 2020.
3. Harsit Srivastava, Dr. Manju Pandey, Amit Kumar, Reema Yadav, Naincy Gupta, Mukesh Kumar Shukla. Formulation and evaluation of alcoholbased hand sanitizer, doi10.48047/ecb/2023.12.si4.913.
4. Firdous Shaikh, Priyanka Bhosale, Snehal More, Formulation and evaluation of hand sanitizer using Psidium guajava leaves extract, published on 30-05- 2020.
5. Organization WH. General guidelines for methodologies on research and evaluation of Traditional medicine 2000. Geneva: World Health Organization.
6. Bent S. Herbal medicine in the United States: Review of efficacy, safety, and regulation. Journal of General Internal Medicine, 2008; 23(6): 854-859. DOI: 10.1007/s11606-008 0632-y.
7. Calixto JB. Efficacy, safety, quality control, marketing and regulatory guidelines for Herbal medicines (phytotherapeutic agents). Brazilian Journal of Medical and Biological Research, 2000; 33: 179-189. ISSN: 0100-879X.
8. Saxena M, Saxena J, Nema R, Singh D, Gupta A. Phytochemistry of medicinal plants. Journal of Pharmacognosy and Phytochemistry, 2013; 1(6): 168-182. ISSN: 2278-4136.
9. Hasler CM, Blumberg JB. Symposium on phytochemicals: Biochemistry and physiology. Journal of Nutrition, 1999; 129: 756-757. ISSN: 756.
10. Ndhlala AR, Stafford GI, Finnie JF, Staden JV. Commercial herbal preparations in KwaZulu Natal, South Africa: The urban Face of traditional medicine. South African Journal of Botany, 2011; 77: 830-843. DOI: 10.1016/j.sajb.2011.09.002.
11. Cano JH, Volpato G. Herbal mixtures in the traditional medicine of Eastern Cuba.Journal of Ethnopharmacology, 2004; 90(2-3): 293-316. DOI: 10.1016/j.jep.2003.10.018:57 pm.
12. Sahay A. Chemicals in Medicines: Roles, Types and Examples [Internet], Embibe, 2023 Jun 21. [cited 2025 Apr 23].

13. Fatima Grace G, Sowmya KV, Darsika C, Arul Jothy, Shanmuganathan S. Polyherbal hand sanitizer - Formulation and evaluation. Dept. of Pharmaceutics, Sri Ramachandra University, Tamil Nadu.
14. Singh, Deepika; Chaudhuri, Prabir K. (2018-08-01). "A review on phytochemical and pharmacological properties of Holy basil (Ocimum sanctum L.)". Industrial Crops and Products. 118: 367 382. doi:10.1016/j.indcrop.2018.03.048. ISSN 0926-6690.Shulman L. Hand sanitizer: benefits & limitations. Canadian Living: Prevention & Recovery, Nov 10, 2006.
15. Cambridge Advanced Learner's Dictionary & Thesaurus. Cambridge: Cambridge University Press, 2012. [cited 2025 Apr 28].
16. Maheshwari S. Bhoge, Shamalila B. Bavage, Nandkishor B. Bavage From "Evaluation And Formulation Of Herbal Hand Sanitizer" An "International Journal Of Research Publication Reviews", From Page No. 784- 786.
17. Dr. Mona Piplani, Dr. Varinder Singh, a practical book of pharmaceutical Microbiology, nirali prakashan, second edition, march 2021.