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A Review on Herbal Hand Sanitizers: Formulation, Efficacy and Applications

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Abstract

Hand hygiene is a critical component in preventing the transmission of infectious diseases. Hand sanitizers have emerged as convenient alternatives to hand washing with soap and water, particularly in situations where access to water is limited. Conventional alcohol-based hand sanitizers are effective but are often associated with adverse effects such as skin dryness, irritation, and potential toxicity on prolonged use. Herbal hand sanitizers, formulated using plant-based extracts with antimicrobial properties, offer a safer and eco-friendly alternative. This review article highlights the importance of herbal hand sanitizers, their formulation aspects, commonly used medicinal plants, mechanisms of antimicrobial action, evaluation parameters, advantages, limitations, and future prospects. The review aims to provide a comprehensive understanding of herbal hand sanitizers and their growing relevance in pharmaceutical and healthcare sectors.

Keywords: Herbal hand sanitizer, antimicrobial activity, medicinal plants, formulation, hand hygiene

1. Introduction

The human hand acts as a primary carrier of microorganisms and plays a significant role in the transmission of infectious diseases. Pathogens such as bacteria, viruses, and fungi can easily spread through direct contact, making hand hygiene an essential preventive measure. Traditionally, hand washing with soap and water has been recommended; however, in modern lifestyles, hand sanitizers have become increasingly popular due to their convenience and rapid action.

Chemical-based and alcohol-based hand sanitizers dominate the market, but their frequent use may lead to skin dryness, dermatitis, and disruption of normal skin microflora. In contrast, herbal hand sanitizers utilize natural plant extracts known for their antimicrobial, antifungal, antiviral, anti-inflammatory, and antioxidant properties. These formulations are generally safer, biodegradable, and more acceptable for long-term use. The rising interest in herbal products has encouraged research into plant-based hand hygiene solutions.

2. Importance of Hand Hygiene

Hand hygiene is recognized globally as one of the most effective ways to reduce the spread of infections. According to healthcare guidelines, proper hand hygiene can significantly decrease hospital-acquired infections and community-based disease transmission. During outbreaks and pandemics, such as COVID-19, the demand for hand sanitizers increased dramatically.

Herbal hand sanitizers play an important role by providing antimicrobial protection while maintaining skin health. They are particularly beneficial for individuals with sensitive skin, children, and healthcare professionals who require frequent hand sanitization.

3. Herbal Hand Sanitizers

Herbal hand sanitizers are formulations prepared using extracts or essential oils obtained from medicinal plants. These plants contain bioactive compounds such as alkaloids, flavonoids, tannins, terpenoids, phenolic compounds, and essential oils that exhibit antimicrobial activity.

3.1 Commonly Used Herbal Ingredients

Some of the widely used herbal ingredients in hand sanitizer formulations include:

- Neem (*Azadirachta indica*): Possesses strong antibacterial, antifungal, and antiviral properties.
- Tulsi (*Ocimum sanctum*): Known for its antimicrobial and immunomodulatory effects.
- Aloe vera (*Aloe barbadensis*): Acts as a soothing, moisturizing agent with antimicrobial activity.
- Tea tree oil (*Melaleuca alternifolia*): Exhibits broad-spectrum antimicrobial action.
- Clove (*Syzygium aromaticum*): Contains eugenol, which has potent antiseptic properties.
- Lemon (*Citrus limon*): Rich in citric acid and essential oils with antibacterial effects.

4. Formulation of Herbal Hand Sanitizers

The formulation of herbal hand sanitizers involves selecting suitable plant extracts and excipients to ensure stability, efficacy, and user acceptability.

4.1 Types of Formulations

- Gel-based formulations: Most commonly used due to ease of application and better skin adherence.
- Liquid formulations: Spray or rinse-free solutions.
- Foam-based formulations: Provide uniform coverage and reduced wastage.

4.2 General Composition

A typical herbal hand sanitizer formulation may include: - Herbal extracts or essential oils - Gelling agents (e.g., carbopol, xanthan gum) - Humectants (e.g., glycerin, aloe vera gel) - Preservatives (natural or approved synthetic) - Purified water

5. Mechanism of Antimicrobial Action

Herbal extracts exert antimicrobial effects through various mechanisms such as: - Disruption of microbial cell membranes - Inhibition of protein and nucleic acid synthesis - Interference with enzyme activity - Antioxidant activity leading to microbial cell damage

The presence of multiple bioactive compounds reduces the risk of microbial resistance compared to single-compound synthetic agents.

6. Evaluation Parameters

Herbal hand sanitizers are evaluated using several parameters to ensure quality and efficacy:

- Physical evaluation: Color, odor, appearance, and homogeneity
- pH determination: To ensure skin compatibility
- Viscosity: For gel formulations
- Spreadability: Ease of application
- Antimicrobial activity: Tested against common pathogens such as *Escherichia coli*, *Staphylococcus aureus*, and *Candida albicans*
- Stability studies: To assess shelf life

7. Advantages of Herbal Hand Sanitizers

- Minimal side effects and skin irritation
- Presence of moisturizing and nourishing agents
- Eco-friendly and biodegradable
- Reduced risk of microbial resistance
- Pleasant natural fragrance

8. Limitations

Despite their benefits, herbal hand sanitizers also have certain limitations: - Variation in efficacy due to plant source and extraction method - Shorter shelf life compared to synthetic products - Limited standardization and regulatory challenges

9. Future Prospects

With increasing consumer awareness and preference for natural products, herbal hand sanitizers have significant market potential. Further research on standardization, clinical efficacy, and large-scale production can enhance their acceptance in healthcare settings. Incorporation of nanotechnology and novel delivery systems may further improve their antimicrobial effectiveness.

10. Conclusion

Herbal hand sanitizers represent a promising alternative to conventional chemical-based sanitizers. Their antimicrobial efficacy, safety profile, and additional skin-friendly properties make them suitable for regular

use. Continued research and development can help overcome existing limitations and establish herbal hand sanitizers as effective hand hygiene products in pharmaceutical and healthcare industries.

Declaration of Conflicting Interests

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