

Use of medical-grade honey in the prevention and management of surgical site infections (SSIs)

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Abstract

Surgical site infections (SSIs) represent a significant challenge in postoperative care, leading to increased morbidity, prolonged hospital stays, and higher healthcare costs. In light of rising antimicrobial resistance, alternative approaches to infection management are increasingly important. Medical-grade honey, it has emerged as a promising adjunct in SSI prevention and management due to its potent antimicrobial, anti-inflammatory, and wound-healing properties. This review explores the mechanisms by which medical-grade honey can mitigate infection risk, summarizes clinical evidence supporting its efficacy, and discusses considerations for its integration into clinical practice.

Keywords: Surgical site infections, *Escherichia coli*

Introduction

Surgical site infections (SSIs) account for a substantial proportion of healthcare-associated infections and can lead to severe complications in postoperative patients. Surgical site infection (SSI) is defined as the infection of the surgical site within 30 days of operation. It can be superficial incisional (involving skin and subcutaneous tissue), deep incisional (including the fascia or muscle layers) or organ/space SSI. The traditional approach to managing SSIs has relied heavily on prophylactic antibiotics and antiseptics. However, the rise in multidrug-resistant pathogens has necessitated exploration into alternative strategies for infection control.¹ The global pooled incidence of SSI is 2.5% with highest incidence in African countries (7.2%) and the lowest in the Western Pacific Region (0.6%).² The incidence of SSI in LMIC is 11.8%,³ and in India ranges between 1.6% to 38%.⁴ This variation is mainly due to the population studied, hospital settings and infection prevention and control practices.

Medical-grade honey has been used for centuries in wound care and is now gaining attention in modern medicine due to its unique properties that may help prevent and manage SSIs. Medical grade honey is prepared (MGH) from natural honey by several steps: - Pure natural honey without any adulteration is collected and tested as per Indian Ayurveda pharmacopeia standards. It is tested for bacterial load calculation in laboratory followed by sterile packaging. Then it is exposed to gamma irradiation for appropriate dose for sterilization. The cost of MGH is high for expenses of testing, packaging, gamma irradiation & maintaining sterility.

This review delves into the benefits, mechanisms of action, and current clinical evidence surrounding the use of medical-grade honey in surgical settings.

Mechanisms of Action of Medical-Grade Honey

1. **Antimicrobial Properties:** Medical-grade honey, particularly Manuka honey derived from the *Leptospermum scoparium* plant, exhibits broad-spectrum antimicrobial activity, largely attributed to its

high methylglyoxal (MGO) content. MGO disrupts bacterial cell walls, causing cell lysis and inhibiting microbial growth. Furthermore, honey's low water activity and high osmolarity draw moisture out of the wound and create an environment unsuitable for bacterial survival. Studies have shown that medical-grade honey is effective against a range of pathogens, including *Staphylococcus aureus* (including MRSA strains), *Pseudomonas aeruginosa*, and *Escherichia coli*, which are commonly implicated in SSIs.^{5,6} Local studies in India have reported that honey is effective against common pathogens in wound infections, including *Staphylococcus aureus* (MRSA strains), *Pseudomonas aeruginosa*, and *Escherichia coli*. Honey has also demonstrated an ability to interfere with biofilm formation, a crucial factor in antibiotic resistance and the persistence of infections in wounds. A prospective randomized clinical and histological study on superficial burn wound healing compared the effects of honey with silver sulfadiazine, revealing honey's potential in managing wound infections effectively.^{7,8}

2. **Anti-Inflammatory and Immunomodulatory Effects:** Inflammation plays a critical role in the wound-healing process; however, excessive or prolonged inflammation can impede healing and increase infection risk. Honey's anti-inflammatory properties help reduce swelling, redness, and pain around the surgical wound, contributing to a more favorable healing environment. It has been shown to reduce the levels of inflammatory cytokines, such as TNF-alpha and IL-6, in wound tissue, which can limit further immune response and reduce scarring.⁹
3. **Promotion of Wound Healing:** Medical-grade honey creates an acidic environment (pH of 3.2-4.5) that stimulates fibroblast activity and collagen synthesis, both essential for wound repair and epithelialization. Additionally, honey promotes autolytic debridement, helping to remove necrotic tissue and accelerate the

healing process. Its high sugar content also provides a source of glucose, which is critical for energy production and tissue repair. A case-control study comparing the effectiveness of honey with conventional dressings for chronic leg ulcers demonstrated superior healing outcomes with honey, indicating its potential as a more effective wound treatment option.^{10,11}

Comparison with Conventional Wound Care Agents:

Studies comparing honey to traditional antiseptics and antibiotic ointments have demonstrated that honey is often equally or more effective in reducing microbial load and infection rates. For instance, in a comparison of honey and silver dressings, honey showed superior outcomes in infection control, wound healing time, and cost-effectiveness.¹²

Clinical Evidence of Efficacy in SSI Management

1. **Prevention of SSIs:** Several clinical studies have evaluated the efficacy of medical-grade honey in preventing SSIs, with promising results. In a randomized controlled trial involving orthopedic patients, topical application of Manuka honey was associated with significantly lower rates of postoperative infections compared to conventional dressings.¹³ Similarly, in gynecological surgeries, honey dressings led to reduced SSI rates, faster wound healing, and decreased patient discomfort.^{14,15}
2. **Treatment of Infected Surgical Wounds:** Honey's ability to manage infections in already-infected surgical wounds has also been documented. For example, a case series involving patients with infected cesarean wounds treated with Manuka honey dressing reported rapid resolution of infection and improved wound healing times compared to standard care.¹⁵ Additionally, in diabetic foot surgery, Manuka honey has been used successfully to manage infected wounds, showing faster healing and infection resolution.¹⁶
3. **Diabetic Foot Ulcers:** Diabetic foot ulcers are a common and challenging problem in India, leading to high rates of infection, amputation, and mortality. Clinical trials using honey in diabetic foot ulcer management have shown positive outcomes. One study conducted in Mumbai demonstrated that honey dressings resulted in faster wound closure, reduced bacterial load, and shorter hospital stays compared to conventional treatments.¹⁷
4. **Chronic Wounds and Pressure Ulcers:** In chronic, non-healing wounds and pressure ulcers, honey has shown significant benefits in Indian patients, especially elderly or bedridden individuals with limited mobility. Research conducted in India found that honey dressings improved granulation tissue formation and wound contraction, facilitating closure in non-healing pressure ulcers.^{18,19}

Practical Considerations for Clinical Use in India

1. **Standardization and Quality Control:** Only sterilized, medical-grade honey should be used to ensure safety and efficacy. In India, where Manuka honey can be cost-

prohibitive, local variants like Tualang and multiflora honey have shown promising antimicrobial activity. Standardized honey products with consistent methylglyoxal content are preferred, as variations in honey type can lead to inconsistent outcomes.

2. **Application Techniques:** Honey dressings can be directly applied to the wound or used in impregnated dressings, with the frequency of changes depending on exudate levels. Indian guidelines recommend closely monitoring wound healing and ensuring proper application techniques to maximize therapeutic benefits. In cases of large or heavily exuding wounds, healthcare providers may need to adapt honey application frequency or supplement honey treatment with standard dressings.
3. **Economic Considerations:** While medical-grade Manuka honey is relatively expensive, locally-sourced honey variants offer a cost-effective alternative that still provides comparable results in infection control and wound healing. Studies support honey's cost-benefit advantage over certain antibiotics and dressings, making it an attractive option for wound management in rural and underserved healthcare settings in India.

Challenges and Future Directions in India

Challenges in integrating honey into clinical practice in India include limited awareness among healthcare providers and concerns regarding standardization of locally-sourced honey. Although research on Indian honey varieties shows promise, more large-scale, controlled studies are necessary to confirm its safety, efficacy, and optimal application protocols across various wound types and patient populations. Educating healthcare providers and developing regulatory standards for medical-grade honey products will be essential to facilitate its adoption in both urban and rural healthcare settings.

Further research is also warranted on the comparative efficacy of different honey types in wound management, especially focusing on Indian honey varieties, which may offer cost-effective alternatives to Manuka honey. Understanding these regional differences will enable the development of tailored treatment protocols that address the unique challenges of wound care in India.

Conclusion

Medical-grade honey, with its antimicrobial, anti-inflammatory, and wound-healing properties, represents a valuable addition to the management of SSIs, diabetic foot ulcers, burns, and chronic wounds. In India, where infections are a frequent complication and healthcare costs are a concern, honey offers a natural, effective, and affordable solution for infection control and wound care. While additional research is needed to standardize protocols and broaden clinical adoption, current evidence supports honey's potential to improve patient outcomes, reduce infection rates, and enhance wound healing. Incorporating honey into wound care, particularly in resource-limited settings, could significantly impact patient care and support the healthcare

system's broader goal of accessible, sustainable wound management options.

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None.

Conflict of Interest

None.

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