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Bactericidal Activity of Different Types of Honey Against Clinical and Environmental Isolates of *Pseudomonas aeruginosa*

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ABSTRACT

Objectives: Honey has had a valued place in traditional medicine for centuries. Renewed interest in honey for various therapeutic purposes, including treatment of infected wounds, has led to the search for different types of honey with antibacterial activity. In this study, we have assessed the antibacterial activity of different types of honey (manuka honey from Australia, heather honey from the United Kingdom, and locally marketed Indian honey).

Methods: The agar dilution method was used to assess the antibacterial activity of honey against 152 isolates of *Pseudomonas aeruginosa* by determining minimum inhibitory concentrations.

Results and conclusions: The locally available (khadikraft) honey produced the best activity against *Pseudomonas aeruginosa* and was found to be better than all of the imported varieties of therapeutic honey.

INTRODUCTION

The medicinal use of honey has been known since ancient times, and in more recent years it has been rediscovered as a therapy for wounds. Honey has been useful in the treatment of infected surgical wounds, burn wounds, and decubitus ulcers.[1] Honey maintains a moist wound environment that promotes healing, and its high viscosity helps to provide a protective barrier to prevent infection. In addition, the mild acidity and low-level hydrogen peroxide release assists both tissue repair and contributes to the antibacterial activity.[2]

The antibacterial activity of honey varies with the plant source and at present only in honeys from *Leptospermum* species; for example, manuka honeys are sold with standardized levels of antibacterial activity. The source of manuka honey in New Zealand is the manuka bush, *Leptospermum scoparium*, and more recently, a honey with the same properties has been found to be produced from *L. polygalifolium*, which grows uncultivated in a few parts of Australia. Heather honey is the commercially available honey in the UK extracted from the floral source of *Calluna vulgaris*, belonging to the family Ericaceae.[3]

The potential of honey as a topical wound dressing is now recognized by the health care community, and there continues to be a search for honeys from different sources with enhanced antibacterial activity.

In this study, we investigated the antibacterial activity of four different types of honey (including two Indian varieties) against strains of *Pseudomonas aeruginosa*.

MATERIALS AND METHODS

The types of honey used in this study were manuka honey (Australia), heather honey (UK), khadikraft honey (India), and honey that was procured from local beekeepers in a south Indian village. The antibacterial activity of the honey was tested against a total of 152 strains of *P. aeruginosa* that were isolated from chronic suppurative otitis media (56), diabetic foot ulcers (25), burn-wound infections (17), blood (14), and from the hospital environ-

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ment (40). *P. aeruginosa ATCC 27853* was included as a control.

The agar dilution method was used to assess the antibacterial activity of honey against these strains. Dilutions were prepared by mixing honey with sterile Mueller Hinton agar to get different concentrations ranging between 1% and 25% (v/v). A plate of nutrient agar without honey served as growth control. A plate of nutrient agar with honey was also included to check the sterility of honey and the medium used in the test. Minimum inhibitory concentration (MIC) of chloroxylenol (Dettol; Reckitt Benckiser (India) Limited, Mysore, India) was tested under similar conditions and served as control.[4] Strains of *P. aeruginosa* were grown in nutrient broth at 37°C for 4 hours, the turbidity was adjusted to 0.5 McFarland's standard, and 10 μL of culture was spot inoculated on the surface of the medium. The plates were incubated at 37°C for 24 hours and were observed for growth. MIC was recorded as the lowest concentration of honey that prevented growth of the test isolates.

Table 1. Minimum Inhibitory Concentrations (MICs) of Different Honeys Against Clinical and Environmental Isolates of *Pseudomonas aeruginosa* (N = 152)

Source of the isolates (no.)	*MICs of honeys tested in %*			
	Manuka honey	*Heather honey*	*Khadikraft honey*	*Local honey*
Chronic suppurative otitis media (56)	20	20	11	20
Burn wound infection (17)	20	20	11	20
Diabetic foot ulcers (25)	20	20	11	20
Blood (14)	20	20	11	20
Environmental isolates (40)	20	20	11	20
P. aeruginosa ATCC 27853	10	10	11	10

RESULTS

The results of the antibacterial activity of the different types of honey are given in Table 1. All of the isolates grew at concentrations ranging from 1% to 10% (v/v) of the honey tested. The MIC varied for the different types of honey tested. Chloroxylenol was used as the antiseptic control and the MIC of chloroxylenol tested in a similar way was found to be 15% for all of the isolates of *P. aeruginosa*. Locally procured honey from Khadikraft was the best with 11% MIC. All the other types of honey tested gave a MIC of 20% against all strains of *P. aeruginosa*. The ATCC strain alone gave a MIC of 10% to 11%.

DISCUSSION

Pseudomonas species are notoriously resistant to antimicrobial therapy. Dead or poorly perfused wound tissue allows the bacteria to multiply and elaborate an array of virulence factors that can delay wound healing.

P. aeruginosa within the wound tissue is protected from host immune effectors and can grow to sufficient levels to elaborate toxins that break down host factors, particularly fibrin and collagen molecules, which are essential for tissue regeneration. Hence, *Pseudomonas* is a major problem for chronic wounds and contributes to delay in healing.[5]

Several laboratory studies have evidence to support the use of honey as a wound dressing.[6] Honey has been shown to stimulate cytokine production by monocytes, which in turn initiates tissue repair. Honey has broad-spectrum antibacterial activity; however, different honeys vary substantially in the potency of their antibacterial activity. Honey debrides wounds, removes malodor, and its anti-inflammatory activity reduces edema and exudates and minimizes scarring. It stimulates the growth of granulation tissue and epithelial tissue and promotes wound healing. In this study, both locally obtained unprocessed honey and commercially processed therapeutic honey have shown antibacterial activity against *P. aeruginosa*. Cooper has reported that manuka honey had MIC of less than 10% against 17 strains of *P. aeruginosa* from infected wounds.[7] Molan reported that Manuka honey had a MIC of 6% against *P. aeruginosa* strains from infected burns.[8] Nzeako and Hamdi, in their study of six commercial honeys, found that *Escherichia coli* and *P. aeruginosa* were inhibited at a concentration of 40%.[9] In our study, the MICs for both manuka honey and heather honey was 20% MIC. Honey procured from Khadikraft showed better activity with a MIC of 11%. Honey procured from local beekeepers had a MIC of 20%, which was quite similar to the other commercially available therapeutic honeys.

Considering the enormous potential for the use of honey in a clinical setting, it is important that research continue not only using honeys that are commercially available but also with the locally available honeys. This study has shown that local products may have equal or sometimes better effectiveness than commercially available therapeutic honey.

P. aeruginosa is an important cause of wound infections. It produces a range of enzymes to assist invasiveness, causing tissue breakdown at the site of infection.[10] Hence, control of infection is of great importance in assisting with tissue repair and wound healing. Honeys, which have a MIC of 10% to 20%, can be expected to be effective in preventing growth of *Pseudomonas* on the wound surface, taking into consideration that the honey applied on the wound may be diluted at least tenfold by wound exudates. This study

has tested only the antibacterial effects of different types of honey. Further studies involving *in vivo* models may be necessary to test wound-healing properties.

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