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Review Article

Honey in wound care: antibacterial properties

Medizinischer Honig in der Wundbehandlung: antibakterielle Eigenschaften

Abstract

Honey is an ancient wound treatment that was re-introduced into modern medical practice in Australasia and Europe following the development of regulated wound care products. Its therapeutic properties are attributed to its antimicrobial activity and its ability to stimulate rapid wound healing. This review will briefly describe the evidence that demonstrates its antimicrobial activity in vitro and in vivo.

Keywords: honey, professional wound care, antibacterial activity

Zusammenfassung

Honig wird von alters her als Mittel zur Wundbehandlung eingesetzt und wurde in den letzten Jahrzehnten in Australien, Neuseeland und schließlich auch in Europa wieder in das Spektrum der professionellen antibakteriellen Wundtherapie eingeführt. Der therapeutische Nutzen der Anwendung von medizinischem Honig beruht auf seiner antibakteriellen Aktivität und seiner Fähigkeit, die Wundheilung zu beschleunigen. Diese Übersicht beschreibt in vitro und in vivo Belege für die antibakterielle Aktivität des medizinischen Honigs.

Schlüsselwörter: Honig, professionelle Wundbehandlung, antibakterielle Aktivität

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Introduction

Honey is a sweet, sticky substance that is produced by bees following the collection of nectar and honeydew. It has been highly prized by man for thousands of years not only as a foodstuff, but as a sacred material and as a medicine. The earliest record of its use in a wound treatment is an inscription on a fragment of a clay tablet dated to approximately 4500 years ago that described a recipe for an ointment. Although honey was used widely in treating wounds by ancient civilizations and it is still utilised in remote communities, it fell into disuse in modern medicine during the 1970s. Its re-introduction depended upon the development of wound care products that achieved approval by regulatory authorities, and its acceptance rested on evidence of clinical efficacy. The first modern product to gain regulatory status was Medihoney. It was licensed as a complementary therapy by the Australian Therapeutic Groups Administration in 1999 and has since become CE marked and is being used in Europe. In the UK the first CE marked wound dressing to gain drug tariff status in 2004 was tulle impregnated with active manuka honey. A range of honey wound care products are now available throughout Europe, Australia and New Zealand and some are expected to be introduced into North America. Much anecdotal evidence supports the use of honey in treating wounds and the extent of clinical evidence is often under-estimated [1]. Essentially the benefits of honey can broadly be summarised by its antimicrobial effects and its influence on rates of healing. The former effects will be addressed in this review.

The evaluation of the potency of honeys

The antimicrobial nature of all honeys is clearly demonstrated by the ability to remain unspoiled by micro-organisms despite prolonged storage at room temperature. Its high sugar content, low water content and acidity [2] provide unsuitable conditions to promote the growth of micro-organisms. Some honeys, however, possess additional antimicrobial factors that are detectable on dilution [3]. A survey of 345 New Zealand honeys employed an agar diffusion assay to characterise the nature of this activity and to divide honeys into three distinct categories: those that did not produce zones of inhibition on dilution during the assay, those whose zones of inhibition were removed in the presence of catalase (an enzyme that

breaks down hydrogen peroxide) and those that produced zones of inhibition in the presence of catalase [4]. Hence honeys were divided into those whose activity was confined to their high sugar content, low moisture content and acidity, or those that exclusively generated low levels of hydrogen peroxide on dilution, or those that retained activity that was independent of the synthesis of hydrogen peroxide on dilution. The latter two honeys were described as peroxide honeys or non-peroxide honeys, respectively. The ability to generate hydrogen peroxide has been shown to be due to the oxidation of glucose by glucose oxidase, which is an enzyme secreted by the bee as it deposits nectar and honeydew into the hive [5]. Peroxide honeys are not uncommon: an investigation into the antibacterial activity of 42 Canadian honeys against two bacterial species, for example, showed that all possessed activity that was associated with the production of hydrogen peroxide [6].

Non-peroxide honeys, however, are less common. Manuka honey from New Zealand and jelly bush honey from Australia are two examples of non-peroxide honeys which are postulated to possess unidentified active components in addition to the production of hydrogen peroxide [3]. Samples of such honeys that demonstrate activity in the above assay have been recommended for utilisation in modern wound care products [7]. Additionally, honeys selected for medicinal use should be produced under hygienic conditions, from traceable sources, with minimal contamination by pesticides, antibiotics or pollutants [8].

The inhibition of micro-organisms by honey in laboratory tests

Many studies illustrating the antimicrobial activity of honey have been published [3], [9], and at least 80 species have been shown to be inhibited by honey. The differing methodology and the variety of honey samples tested, however, provide inconsistent data on the susceptibility of specific micro-organisms. In relation to wounds, the sensitivity to honey of bacteria capable of causing infection has been investigated in New Zealand [10], the United Arab Emirates [11] and in Australia [12]. In our laboratory we have tested cohorts of clinical isolates derived from infected wounds to demonstrate susceptibility to active manuka honey [13], [14], [15]; using a sugar syrup solution containing the four main sugars found in honey, we have shown that the inhibition of staphylococci, enterococci and pseudomonads in laboratory tests is not attributable to these sugars alone. It has also been demonstrated that antibiotic-sensitive strains and their respective antibiotic-resistant strains are equally susceptible to active manuka honey [13], [14], [15], [16]. Not only are antibiotic resistant bacteria inhibited by honey, but the synergistic action of honey and antibiotics has been reported [17]. Fungal wound pathogens [18], [19] and protozoa are also inhibited by honey [20].

The efficacy of honey in the eradication of bacteria from wounds

The inhibition of microbial species by honey in vivo has the potential to clear infection, remove malodours and prevent cross-infection [1]. Much clinical evidence has been published to support the use of honey in enhancing wound healing [1]; the number of patients included in published studies now exceeds 2000. One of the most interesting observations on the clinical use of honey has been its success in eradicating methicillin-sensitive *Staphylococcus aureus* (MRSA) from colonised chronic wounds [21], [22], [23], [24], [25]. It has been used successfully on a diabetic foot ulcer in a patient who was threatened with amputation [25] and it has become a first-line treatment in at least one surgical unit [23], instead of the one of last resort.

Conclusion

Honey is a broad spectrum antimicrobial agent of varying potency, but honeys suitable for wound treatment can be readily selected by an agar well diffusion assay. Honey has a complex chemical composition and neither the identities of all of its inhibitory components nor its mechanisms of action are yet completely understood. Laboratory tests have demonstrated the effective inhibition of a wide range of microbial species, with both antibiotic-sensitive and antibiotic-resistant bacteria showing susceptibility. The publication of case reports of the eradication of MRSA from patients give validity to in vitro observations, but large scale clinical trials are needed to establish its clinical efficacy. With the increased availability of licensed wound care products containing honey, clinical use is expected to increase and further evidence will become available. Honey seems to have the potential to clear infection as well as being an effective prophylactic agent that may contribute to reducing the risks of cross-infection. Time will demonstrate whether the present optimism about honey is justified.

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