

CHAPTER 3

IMPLICATIONS OF HONEY DRESSINGS WITHIN PRIMARY CARE

Jackie Stephen-Haynes

Introduction

The challenge of wound care within the primary care setting relates to two key areas: healing or managing symptoms. While the objective would ideally be healing, chronic wound management hinges on managing symptoms. Honey has been used historically for its therapeutic properties, including, the promotion of rapid wound healing, reducing oedema, debriding necrotic tissue, reducing inflammation, stimulating tissue regeneration as a topical treatment for infected wounds (Molan, 2002; Vander Weyden, 2003), and can be effective on antibiotic resistant strains of bacteria (Molan, 1992; Cooper and Molan, 1999; Cooper *et al*, 1999; Dunford *et al*, 2000). Therefore, the effectiveness of honey should be judged on the purpose for the intervention, whilst acknowledging the additional components.

Pure honey is a semi-translucent concentrated mixture of glucose, fructose, proteins, fatty acids, minerals, vitamins and water produced by worker bees from the nectar of flowers. Honey varies due to the pollen content and floral source from which it is obtained. Nectar is a weak natural sugar solution that the bees convert through enzymatic action into honey, which is stored in cells within the hive and covered with a thick waxy substance (beeswax) as a food store.

Until now, honey has not been developed and specified as a wound management product, and has not been regulated by pharmaceutical or Medical Device standards. The first honey dressing available on FP10 (UK prescription) was Activon™ tulle (Advancis Medical), which is a low adherent sterile dressing, impregnated with 20–25g of Manuka honey per 10 cm x 10 cm and 5–6g per 5 cm x 5 cm dressing. New dressings

combining honey with a functional 'carrier' are becoming available; for example, honey with alginate or hydrogel sheet. This offers an ancillary action such as extra exudate handling capacity in the case of alginate-honey combination.

To safeguard the patient and act in accordance with the Nursing and Midwifery Council (NMC) (2002), it is important that only products that are a pharmaceutical device or available as CE Medical Devices are used on patients. This is particularly important in relation to honey dressings, as they are easily available from non-medical sources in a non-sterile form. It is essential that honey used for medicinal purposes is pure and free from synthetic pesticides. Some honey contains phytochemicals associated with anti-bacterial activity (Molan 2001). Honey from Manuka has a high level of these (Allen *et al*, 1991) and, as such, is among the highest potency honey available in the world. Manuka is the local Maori name for the New Zealand tea tree *Leptospermum scoparium*. Australian honey is reported to have a less effective antimicrobial effect (Molan, 2001), but further research would be needed to confirm or refute this.

Honey may, therefore, be a useful addition to the current range of products as it has several attributes (Molan, 1999):

- ⌘ Antimicrobial
- ⌘ Deodorisation
- ⌘ Debriding
- ⌘ Anti-inflammatory
- ⌘ Stimulation of new tissue growth

Antimicrobial activity

Chronic wounds, such as leg ulcers and pressure ulcers, are commonly infected or heavily colonised with bacteria (Scanlon and Stubbs, 2002; Booth, 2003). Much of the research about honey is related to its anti-bacterial properties (Molan, 1992; Cooper and Molan, 1999; Cooper *et al*, 1999; Dunford *et al*, 2000).

While clinical criteria for identifying wound infection has been identified by Cutting and Harding (1994), this is considered too generic (Cutting and White, 2004), and healthcare professionals are encouraged to consider the major categories of wounds separately to avoid overlooking the possibility of infection. Indeed, determining infected and non-infected

wounds has become more complicated as other criteria for recognising infection are increasingly recognised. Certainly, the 'granulating' or 'red' wound may be healing in a normal way, or may appear as red when infected with haemolytic streptococci (Gray *et al* 2003). With the recognition of terms such as 'critically colonised', a wound swab is no longer conclusive that a wound is free from infection. Although the wound swab may be negative, there is delayed healing with a host reaction, which commonly responds to an antimicrobial dressing such as iodine, silver or honey. These differentiations are not easily defined by microbiological characterisation or quantification, and practitioners find it increasingly difficult to differentiate in clinical practice. The Wound Infection Continuum, as part of applied wound management, is useful (Kingsley, 2001a; White, 2003b).



The Wound Infection Continuum

The following criteria for wound infection should also be utilised as a guide (Cutting and Harding, 1994):

- abscess
- cellulitis
- discharge
- delayed healing
- discolouration
- friable, bleeding granulation tissue
- unexpected pain or tenderness
- pocketing, bridging at base of wound
- abnormal smell
- wound breakdown.

Systemic antibiotics are indicated for those with clinical infections, whilst the use of topical antibiotics is generally avoided because of the increase in bacterial resistance (Cooper and Lawrence, 1996). The use of antiseptics is controversial (Scanlon and Stubbs, 2002), as they are non-selective and can be toxic to the host tissue (Booth, 2003). More recently in the UK, the emphasis has been on the use of antimicrobial dressings, which currently account for several million in the UK.

The most commonly used antimicrobial dressings are silver (White, 2003a; Lansdown, 2003) and iodine, which is a topical germicidal agent, effective against bacteria, fungi and protozoa (Hansson, 2001). Despite the availability of these in an increasingly wide range of applications (alginates, foams, lipido-colloids), patients frequently ask about using honey and a surprising number present with Internet searches on honey. The emergence of 'antibiotic resistance', and the growing interest in 'natural' or 'complementary' therapies, has led to an interest in honey dressings. The anti-bacterial effect of honey is related to a number of its properties, including; pH, osmolarity, phytochemicals and the production of hydrogen peroxide. The pH of honey is characteristically between 3.2 and 4.5 and is low enough to inhibit pathogens such as *E.coli*, *Pseudomonas spp*, *Salmonella spp* and *Streptococcus pyogenes* (Molan, 2001).

The anti-bacterial effects of Manuka honey are also assisted by the presence of hydrogen peroxide, an oxidising agent released by the action of the enzyme peroxidase. Hydrogen peroxide is considered unsafe at a high level (Booth, 2003) with a bleaching action that may cause pain (Lawrence, 1997). In honey dressings, hydrogen peroxide is at a very low level (1000 times less than in 3% hydrogen peroxide), is still an effective antibacterial agent (Ambrose *et al*, 1991) and compatible with cellular preservation (Booth, 2003). Healing depends much upon creating equilibrium between host defence mechanisms and the multitude of pathological organisms that occur in the wound environment (Lansdown, 2003).

Topically, hydrogen peroxide removes contaminants, cleanses and deodorises wounds and stimulates macrophage vascular endothelial growth factor, which is released in the initial inflammatory stages of wound healing (Cho *et al*, 2001). Hydrogen peroxide is naturally produced by the body in the cells as a result of glucose metabolism, and is considered to be non-toxic to the host tissue (Booth, 2003). The application of hydrogen peroxide with a similar level to the natural level may trigger responses in the chronic wound, and may restart the healing process. When honey is diluted and applied to the wound it produces hydrogen peroxide at a steady rate, providing a sustained, effective delivery (Booth, 2003). *In vitro* studies support the antimicrobial effect of honey against a wide range of pathogens including beta-haemolytic streptococci, MRSA and *Pseudomonas spp* (Allen *et al*, 1991; Cooper and Molan, 1999). The *in vivo* studies are less conclusive, but honey has been used to treat burns (Efem, 1988), meningococcal lesions (Dunford *et al*, 2000), venous leg ulcers, pressure ulcers, diabetic foot ulcers, donor sites, abscesses and boils (Betts and Molan, 2001). Subrahmanyam (1998) compared honey to silver sulfadiazine and found less inflammation, lower infection rates,

and faster healing in burns patients treated with honey.

The anti-bacterial action may also be responsible for honey's anti-inflammatory effect as well as stimulating new tissue growth (Molan 1999). Conversely, (Kingsley, 2001b) reports two case studies where honey failed to eliminate infection, and Alcaraz and Kelly (2002) report that honey failed to eliminate bacteria from a chronic wound. However, Alcaraz and Kelly (2002) did find an improvement in managing exudate and de-odourisation.

In 1892, Van Ketel (Molan, 2001) noted the high osmolarity of honey, and Cooper (1999) reported that it continued to prevent the growth of *Staphylococcus aureus* when diluted seven to fourteen times. However, this high osmolarity may be reduced in the presence of exudate until it can no longer inhibit infection (Molan, 2001).

This poses the question of whether the evidence indicates that honey dressings should be used in an infected wound, one that is critically colonised, or, for patients who are at risk of developing an infection. Further research is needed and this should be a primary area for focus. The potential for honey may be lost by inadequate research reporting where any honey is evaluated rather than specific honey. The variance in the antimicrobial effect is important and within clinical practice there is a need to ensure that appropriate honey is applied. The case of 'honey in the jar' being effective is largely anecdotal and not reported in the literature.

Deodorising and debriding

Van der Weyden (2003) reports using honey alginate on two patients with pressure ulcers, which led to rapid and complete healing in both wounds and noted a de-odourising and anti-inflammatory effect. Honey is now used as standard treatment in chronic wounds within this particular nursing home. Lisle (2002) reports the use of sugar paste being effective in a single care study. Similarly, Stephen-Haynes (2004) reports case studies where debridement of wounds with three patients and management of odour in five patients occurred. There is clearly a need for the control of malodorous wounds (Scanlon and Stubbs, 2002; Booth, 2003). Hampton (2004) identifies the importance of this with patients with fungating wounds, and recognises the role that community staff will have in providing the care.

Anti-inflammatory and stimulation of new tissue growth

Topham (2002) highlights the effect that honey has on the extra-cellular matrix, and Dunford *et al* (2000) reports significant epithelialisation when honey was used. Marshall (2002) reports the use of honey in podiatry and Templeton (2002) reports the reduction of inflammation and the stimulation of angiogenesis and the formation of granulation tissue. However, the small scales of their research are acknowledged and the need for further exploratory research highlighted.

Dressing selection in clinical practice — choosing honey

The current trend within tissue viability is to consider the concept of wound bed preparation (Falanga, 2000), as well as other traditional factors (Stephen Haynes and Gibson, 2003). Implementing this in clinical practice has been assisted by the development of the acronym TIME: tissue, infection, moisture, and edge (Schultz *et al*, 2003). This has implications for wound management (Dowsett and Ayello, 2004)

Factors to consider in relation to dressing selection (Stephen Haynes and Gibson, 2003) include:

- wound classification
- stage of healing
- aetiology
- tissues involved
- level of exudate
- level of pain
- the peri-wound area
- the patient's general health and environment
- cost-effectiveness of the dressing.

The criteria of an ideal dressing (Turner, 1985), include:

- keeping wound moist
- managing exudate
- allowing gaseous exchange
- thermal insulation of the wound
- protecting from contamination
- protecting from micro-organisms
- protecting the wound from trauma.

Wound bed preparation and T.I.M.E. (Schultz *et al* 2003)

❖ T	Tissue	Tissue non-viable or deficient
❖ I	Infection	Infection or inflammation
❖ M	Moisture	Moisture imbalance
❖ E	Edge	Edge of wound, non-advancing or undermined

It may be useful to consider the mode of honey application in relation to these factors. Assessing the patient and the wound will highlight holistic factors as, in most clinical situations, honey may not be the only active intervention that needs to be employed to effect a result, for example, antibiotics, pressure relief, bed rest, limb elevation and compression bandaging.

The Infection Continuum (White, 2003b) is useful in raising awareness of 'critical colonisation', which may delay healing and, therefore, may be an indicator for an antimicrobial dressing such as honey. The Wound Healing Continuum (Gray *et al*, 2003) offers a useful framework for assessment and classification, and utilising the concept of TIME (Schultz *et al*, 2003) assists with identifying the aim of wound management.

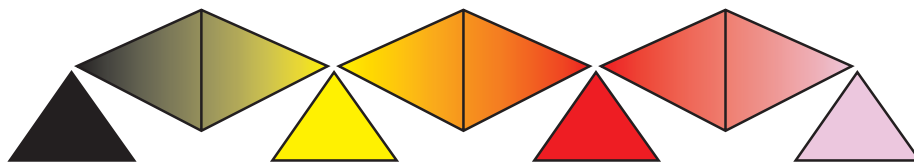
By clearly assessing the wound, the objective can be determined and the mode of application of honey can be considered.

Infection Continuum

Colonisation Critical colonisation Local infection Systemic infection



Wound Healing Continuum



Necrotic, necrotic/sloughy, sloughy, sloughy/granulating, granulating/epithelialisation and epithelialisation

TIME

Tissue Inflammation-Infection Moisture Edge

Debride and restore wound base, remove infection, restore epithelial migration, advancing edge

Application of mode of honey

Ointment/gel honey Honey + alginate Honey tulle Honey + foam/film



Dressing evaluation

A preliminary report of this evaluation has previously been reported in the *British Journal of Nursing* (Stephen-Haynes, 2004).

Some reports on the effectiveness of honey relate to 'generic honey' of an unspecified source. Advancis Medical produce an impregnated non-adherent dressing, which contains Manuka honey. Although honey dressings have been available, they have not been under pharmaceuticals devices or available as CE Medical Devices. The contraindications to the use of honey dressings are allergy to honey and allergy to bee venom. The dressing may be used in patients with diabetes, but they should be monitored closely for absorbency of glucose.

Study method

An evaluation has been undertaken in the Worcestershire primary care trusts. This evaluation contains analysis of Activon™ Tulle (Advancis Medical), which is sterile, non-adherent and impregnated with 20–25g of Manuka honey. The dressing is applied directly to the wound and then secured with bandaging or film, possibly in conjunction with absorbent padding. The lack of evidence of specific wound types that benefit from honey dressings led to all classification of wounds being included in the Wound Healing Continuum (Gray *et al*, 2003), any classification within the Infection Continuum (White, 2003b), and any objective in TIME (Schultz *et al*, 2003). The factors considered were:

- wound position and size
- ease of application and removal
- whether the dressing stayed in place
- management of exudate
- patient comfort
- wound bed condition.

The assessment of each patient included:

- patient demographic information: age, gender, height-weight, body mass index (BMI)
- diabetes

- anaemia
- nutritional status (Russell, 2002)
- pressure ulcer risk assessment (Waterlow, 1985, 2005).

Each wound was assessed (Stephen-Haynes and Gibson, 2003), the dimensions recorded, and photographs were taken with consent from the patient.

Results

Analysis is made of twenty patient episodes with statistical data presented in a chart (*Figure 3.1*).

Of the twenty patients: eleven presented with leg ulceration, two mixed aetiology, one arterial and eight venous (representing a typical percentage of patients commonly seen in practice with each leg ulcer aetiology), one foot ulcer, two burns, two pressure ulcers, one with an injury to the knee, two traumatic skin tears and one drainage of haematoma.

Ease of application

Sixty-five per cent of the evaluations considered the dressing easy to apply, and 30% found it to be average or on a par with other dressings. Five per cent found the application difficult. Such differentiation may relate to the size of the dressing. The dressing is now available as a 10 cm x 10 cm and a 5 cm x 5 cm, which should help application. The 5 cm x 5 cm size is a particularly useful addition for patients with toe/toenail wounds and should be an area of further research.

Ease of removal

Seventy-five per cent evaluated the dressing as being easily removed and 25% found it to be average. All the comments were positive in relation to the ease of removal, and it was considered to be an 'atraumatic' dressing.

Patient	Age	Wound type	Wound classification	Allergies
1	72	Leg ulcer	Sloughy	None
2	83	Mixed aetiology leg ulcer	Granulating/sloughy	None
3	75	Chronic leg ulcer	Granulating	Has reacted to some products
4	89	Ischaemic ulcer	Granulating	None
5	90	Venous leg ulcer	Slough	None
6	76	Venous ulcer	Slough/granulating	Hydrocolloids
7	88	Mixed aetiology leg ulcer	Infected	None
8	75	Venous leg ulcer	Sloughy	None
9	78	Foot ulcer		Granuflex and iodine
10	88	Burn	Granulating	None
11	70	Traumatic skin tear	Granulating	None
12	89	Pressure ulcer grade 2	Slough	None
13	88	Burn	Slough	None
14	68	Injury to left knee	Granulating	Iodine
15	68	Drainage of haematoma	Sloughy	None
16	75	Venous leg ulcer	Sloughy	None
17	69	Laceration to lower leg	Granulating/sloughy	None
18	84	Venous leg ulcer	Sloughy	None
19	58	Traumatic wound	Granulating/sloughy	None
20	72	Pressure ulcer	Granulating/sloughy	None

Figure 3.1: Chart of patient characteristics

Dressing staying in place

Eighty-five per cent of evaluations found the dressing stayed in place as long as recommended. Fifteen per cent found the dressing did not last as long as recommended. This may be related to the level of exudates, and the addition of an alginate component would assist with this. The dressing surface in contact with wound bed is essentially in a fluid state, which means the dressing can be easily lifted off the wound without sticking, and any excess honey easily rinsed away.

Improvement in wound bed

Eighty per cent found an improvement in the wound bed, whilst 20% did not. However, the practitioner needs to consider the objective of using the honey dressing.

Patient comfort

Sixty-five per cent found it to be comfortable, 15% fairly comfortable and 20% found it uncomfortable. It was noted that pain subsided after the first dressing change. The patient may experience a drawing or stinging sensation due to the high osmolarity of the honey. This reduces the water activity of micro-organisms to a level where they are either inert or destroyed.

Wound dressings can be traumatic to the wound bed and the peri-wound area. Controlling pain at dressing change (Hollinworth, 2000) and being an 'atraumatic' dressing (Thomas, 2003) are important criteria. The practitioner should be mindful of pain when considering the application of honey dressings and should advise the patient on an appropriate course of action.

Three individual case studies are included which highlight the results seen within clinical practice.

Case study 1

Mrs H is an eighty-eight-year-old lady who has had lower leg ulceration of mixed aetiology for many years, and whose care is shared between a vascular consultant and a district nursing team. Mrs H is registered blind, has a history of osteo-arthritis and has been wheelchair-bound for approximately thirty years. There have been many episodes of non-concordance regarding her treatment/medication, which have challenged both medical and nursing staff.

Mrs H had previously been treated with high compression bandaging (Tensopress™, Smith and Nephew Limited) and visited the vascular consultant every three months. A holistic assessment of Mrs H was carried out by the district nurse upon admission to the caseload, and she was found to be anaemic and suffering from hypothyroidism, both of which were corrected by her GP.

A wound assessment was completed and Doppler ultrasound was attempted but was unsuccessful, therefore a re-assessment by the vascular team was requested, as, at this time, the ulcers on both lower legs showed signs of deterioration. Following an MRI scan both legs were found to have arterial components that required surgical intervention. An angioplasty was partially successful to the left



Figure 3.2a: Back of the left lower leg, 17/3/03



Figure 3.2b: Front of the left lower leg, 17/3/03



Figure 3.2c: Front of the right lower leg, 17/3/03

leg but unsuccessful to the right (further appropriate surgery is presently being discussed). Over many years various dressings have been used with limited success and, more recently, peri-wound maceration due, in part, to non-concordance of diuretic therapy and high limb elevation had become a real problem as there was marked lower leg oedema.

In considering the continuums, being a leg ulcer it is likely to be at least colonised (Scanlon and Stubbs, 2002), and with the appearance of slough/granulation tissue, it may be critically colonised, explaining the non-healing. The aim on the TIME continuum would be to remove infection. The size of the wound and the level of exudate was such that the addition of an alginate would be beneficial. Honey could be applied with a honey and alginate dressing.

Photographs of both legs were taken prior to first application and at weekly intervals for the first month. Activon™ Tulle (Advancis Medical) was applied to the ulcers on both legs, and extended to cover all of the surrounding badly macerated skin. Daily dressing changes took place initially but, as removal of slough and surrounding skin and the condition of both the ulcer beds improved, these were reduced to alternate days and eventually twice a week.

The dressing was easy to apply and remove but the initial application caused some discomfort, and stinging. This caused an unsettled first night despite regular analgesia; however, Mrs H was determined to



Figure 3.2d: Anterio-lateral side of right lower leg, 24/3/03



Figure 3.2e: Back of the left lower leg, 24/3/03



Figure 3.2f: Front of the left lower leg, 24/3/03

continue with the treatment and subsequent applications of the dressing caused much lower levels of discomfort that settled half-an-hour after application.

The rapid improvement in the peri-wound skin was quite dramatic over the first four weeks, with the initial affected areas of over 10 cm square healing completely, and improvement in the wound beds of each ulcer. Patient concordance of both high elevation and prescribed medication improved over the trial period (this could have contributed, in part, to the dramatic improvement in such a short period of time).

Mrs H's ulcers and badly macerated surrounding skin responded well to treatment during the first four weeks. All broken skin adjacent to both ulcers healed and the ulcer beds looked much healthier than they had done pre-trial evaluation. No wound swabs were taken during this case study, so the antimicrobial effect cannot be corroborated.

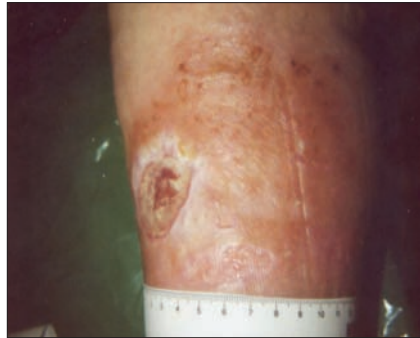


Figure 3.2g: Front of the right lower leg, 31/3/03

Case study 2

Mrs A is aged eighty-eight years and mobile. She sustained a burn on her left upper arm following a fall onto an electric fire. The area measured 20 cm x 15 cm and had been allowed to dry out.

In considering the continuums, the wound appeared necrotic, sloughy (Gray *et al*, 2003), and infected with MRSA (White, 2003b). The treatment objectives were to manage infection and to debride the wound (Schulz *et al*, 2003).



Figure 3.1: Mrs A as at 28 February, 2003

Initial treatment with hydrogel aimed to soften and promote autolysis to remove the eschar. Wound swab showed MRSA infection, which was treated systemically with amoxicillin and flucloxacillin. Mrs A found treatment distressing and, following one and a half weeks of hydrogel treatment, little progress had been made. The eschar remained dry, causing the wound to be tight and painful. Mrs A agreed to evaluate Activon™ Tulle honey with the aim of promoting autolysis and preventing the re-occurrence of infection. Softening of the eschar was seen within a week and the wound was less painful. Within three weeks the wound was visibly debriding. Within ten weeks, total debridement had taken place, and there were visible signs of large areas of epithelialisation. Mrs A found this dressing comfortable to wear and never experienced any pain following application.



Figure 3.2: Mrs A as at 7 March, 2003



Figure 3.3: Mrs A as at 9 May, 2003

Case study 3

Mrs J is eighty-nine years old. She was admitted for rehabilitation following bilateral cellulitis, which had led to reduced mobility. She is obese and presented with a broken area on her left calf, measuring 6 cm x 2 cm. In considering the continuums, the wound (Gray *et al*, 2003) appeared sloughy with minimal exudate with macerated peri-wound area. The wound was not infected and would be classified as colonised (White, 2003b). The aim of the treatment on the TIME continuum

(Schultz *et al*, 2003) would be to prevent infection, and promote granulation. As she was allergic to iodine and topical antimicrobial therapy was indicated, treatment with honey was commenced and the wound healed in approximately four weeks. No pain was reported; the dressing was comfortable and was easily removed.

Conclusion

Clinical governance and evidence-based practice are now an important element of delivering care in the NHS (DoH, 1997). To safeguard the patient and act in accordance with the NMC (2002), it is important that only those products that are a pharmaceuticals device or available as CE Medical Devices are used on patients. This is particularly important in relation to honey dressings, as they are easily available from non-medical sources in a non-sterile form. The existing evidence on honey is largely based on *in vivo* studies, with no confirmation from a well-designed clinical trial.

Perhaps the only relevant studies on the likely usefulness are those undertaken with standardised honey (Molan, 2001). Nevertheless, the mounting evidence suggests that honey has an increasingly important role in wound care, which will be welcomed by the patient who increasingly seeks a 'natural' approach to wound care. The increasing concerns relating to antibiotic resistance, as well as the safety or toxicity of topical antiseptics, provides the impetus to search for a safe agent that can assist in the management of infected and critically colonised wounds, and in the prevention of infection. While an evaluation in clinical practice has limited generalisability, there is a value in any evaluation that is *in vivo* rather than *in vitro*.

The use of antiseptics always needs careful consideration and justification (*Chapter 2*). Honey provides sustained release of hydrogen peroxide at a level which is non-toxic (*Chapter 2*). It also has the ability to manage exudate, debride wounds and be comfortable on the wound (*Chapter 9*). At the time of writing, there are a number of honey-based wound treatments with the CE mark which are available on prescription.

Careful monitoring for any allergic responses or the dressing being an irritant are key concerns. The dressing should not be used by those allergic to honey or bee venom. There may be a risk of hyperglycaemia and the patient will need to be monitored closely.

Based on the experience gathered in these cases, it is clear that honey meets many of the criteria of the ideal dressing (Turner, 1985).

The future

Much needed, further research with honey in the clinical arena is being undertaken, particularly in relation to its role in infection/colonisation and its use as a podiatry dressing. There is a need for evidence from clinical practice to guide future practice and the development of an educational strategy for its use. It is essential that patients with diabetes are included in its usage, and are monitored closely.

The financial cost of infected wounds in the UK may also be a considerable force in the future development of honey dressings. For example, will we soon be witnessing a plethora of dressings and modes of application of honey as we have witnessed with silver? Will we be witnessing a foam dressing impregnated with honey, or a hydrocolloid and honey, or aqueous cream and honey?

While a randomised controlled trial (RCT) or controlled study is needed to guide future practice, those with responsibility for formularies for dressing selection should consider this product as an additional effective wound management product, rather than as an 'alternative treatment', as it has a significant role in wound bed preparation and total care of the patient.

References

- Alcaraz A, Kelly J (2002) Treatment of an infected venous leg ulcer with honey dressings. *Br J Nurs* **11**(13): 859–66
- Allen K, Molan P, Reid G (1991) A survey of the antibacterial activity of some New Zealand honeys. *J Pharmacol* **43**(12): 817–82
- Ambrose U, Middleton K, Seal D (1991) In vitro studies of water activity and bacterial growth inhibition of sucrose-polyethylene glycol 400-hydrogen peroxide and xylose-polyethylene glycol 400-hydrogen peroxide pastes used to treat wounds. *Antimicrobial agents chemotherapy* **35**(9): 799–1803

- Booth S (2003) Are honey and sugar paste alternatives to topical antiseptics? *J Wound Care* **13**(1): 31–3
- Betts J, Molan P (2001) A pilot trial of honey as a wound dressing has shown the importance of the way honey is applied to the wounds. 11th conference of the European Wound Management Association. Dublin, Ireland
- Cho M, Hunt T, Hussain M (2001) Hydrogen peroxide stimulates vascular endothelial growth factor release. *Am J Physiol* **280**: 5
- Cooper R, Lawrence J (1996) Microorganisms and wounds. *J Wound Care* **5**(5): 233–6
- Cooper R, Molan P (1999) The use of honey as an antiseptic in managing *pseudomonas* infection. *J Wound Care* **8**(4): 161–4
- Cooper R, Molan PC, Hardking KG (1999) Antibacterial activity of honey against strains of *Staphylococcus aureus* from infected wounds. *J R Soc Med* **92**(6): 283–5
- Cutting K, White R (2004) Defined and refined: criteria for identifying wound infection re-visited. *Br J Community Nurs* **9**(3) (suppl): s6–s15
- Cutting K, Harding K (1994) Criteria for identifying wound infection. *J Wound Care* **3**(4): 198–201
- Department of Health (1997) *The new NHS modern, dependable*. DoH, London
- Dowsett C, Aayello E (2004) TIME principles of chronic wound bed preparation and treatment. *Br J Nurs* (Tissue Viability supplement) **13**(15): s16–s21
- Dunford C, Cooper R, Molan P, White R (2000) The use of honey in wound management. *Nurs Standard* **15**(11): 63–8
- Efem S (1988) Clinical observations of the wound healing properties of honey. *Br J Surg* **75**(7): 679–81
- Falanga V (2000) Classification for wound bed preparation and stimulation of chronic wounds. *Wound Repair Regen* **8**(5): 347–52
- Gray D, White R, Cooper P (2003) The wound healing continuum. In White RJ, ed. *The Silver Book*. Quay Books, MA Healthcare Limited, London: 1–12
- Hampton S (2004) Managing symptoms of fungating wounds. *J Community Nurs* **18**(10): 22–6
- Hansson C (2001) Iodine therapy. In: Cherry G, Harding K, Ryan T, eds. *Wound Bed Preparation. International congress and symposium*. Royal Society of Medicine Press Ltd, London: chap 7, pp 49–52
- Hollinworth H (2000) Pain and wound care. *Wound Care Society Educational Leaflet* **7**(2) May
- Kingsley A (2001a) A proactive approach to wound infection. *Nurs Standard* **15**(30): 50–8

- Kingsley A (2001b) The use of honey in the treatment of infected wounds: case studies. *Br J Nurs* **22**(10): 12–20
- Lansdown A (2003) Silver in wound care and management. *Wound Care Society Educational Booklet* **11**(3)
- Lawrence J (1997) Wound irrigation. *Wound Care* **6**(1): 23–6
- Lisle J (2002) Use of sugar in the treatment of infected leg ulcers. *Br J Community Nurs* **7**(6) (suppl): 40–6
- Marshall C (2002) The use of honey in wound care: a review article. *Br J Podiatry* **5**(2): 47–9
- Molan P (1992) The anti bacterial activity of honey: 1. The nature of the antibacterial activity. *Bee World* **73**(1): 5–28
- Molan P (1999) The role of honey in the management of wounds. *J Wound Care* **8**(8): 415–18
- Molan P (2001) Honey as a topical antibacterial agent for treatment of infected wounds. Available online at: www.worldwidewounds.com
- Molan P (2002) Re-introducing honey in the management of wounds and ulcers: theory and practice. *Ostomy Wound Management* **48**(11): 28–40
- Nursing and Midwifery Council (2002) *Nursing and Midwifery Code of Professional Conduct*. NMC, London.
- Russell L (2002) The importance of wound documentation and classification. In: White R, ed. *Trends in Wound Care*, volume one. Quay Books, MA Healthcare Limited, London
- Scanlon E, Stubbs N (2002) To use or not to use? The debate on the use of antiseptics in wound care. *Br J Community Nurs* **7**(9) (suppl): s8–s20
- Schultz G, Sibbald G, Falanga V *et al* (2003) Wound bed preparation: a systematic approach to wound management. *Wound Rep Regen* **11**(2): 1–28
- Stephen-Haynes J, Gibson E (2003) Anatomy, physiology wound healing and wound assessment. *Wound Care Society Educational Booklet* **1**(2)
- Stephen-Haynes (2004) Evaluation of honey-impregnated tulle dressing in primary care. *Br J Community Nurs* **9**(6) (suppl): s21–s27
- Subrahmanyam M (1998) A prospective, randomised clinical and histological study of superficial burn wound healing with honey and silver sulphadiazine. *Burns* **24**(2): 157–61
- Templeton S (2002) A review of the use of honey in wounds. *ACCNS J Community Nurses* **7**(1): 13–14
- Thomas S (2003) Atraumatic dressings. World wide wounds. Available online at: www.worldwidewounds.com
- Topham J (2002) Why do some cavity wounds treated with honey or sugar paste heal without scarring? *J Wound Care* **11**(2): 53–5

- Turner T (1985) Which dressing and why. In: Westaby S, ed. *Wound Care*. Heinemann, London
- van der Weyden E (2003) The use of honey for the treatment of two patients with pressure ulcers. *Br J Community Nurs* **8**(12) (suppl): s14–s20
- Waterlow J (1985) Pressure sores: a risk assessment card. *Nurs Times* **81**(48): 49–95
- Waterlow J (2005) *Pressure Ulcer Prevention Manual*. Revised. Available online from: www.judy-waterlow.co.uk
- White R (2003a) An historical overview of the use of silver in wound management. In: White R, ed. *The Silver Book*. Quay Books, MA Healthcare Limited, London
- White R (2003b) The wound infection continuum. In: White R, ed. *Trends in Wound Care*, volume 2. Quay Books, MA Healthcare Limited, London