Bees fly on to curriculum and change how we manage wounds in equines

Author : PATRICK J POLLOCK

Categories : Vets

Date : July 29, 2013

PATRICK J POLLOCK reports on how honey bees are being kept at the University of Glasgow and on a study into the effects of various honeys in wound management

THE honey bee's plight has hit the headlines as a result of increasing numbers of colony losses among amateur and commercial beekeepers, the rise of parasitic diseases such as Varroa, and notifiable diseases including American Foul Brood, plus the use of certain common pesticides.

Consequently, veterinary surgeons have been suddenly faced with questions regarding diagnosis and treatment of honey bee disease, something new for most of us.

In light of this, at the University of Glasgow's vet school, the honey bee (*Apis mellifera*) has found its way on to the undergraduate curriculum. Bee husbandry and management is taught in the early years of the course, with diagnosis and treatment of disease introduced during the clinical phase. The school has eight colonies of bees split between its main Garscube campus and Cochno farm sites allowing students hands-on exposure to both rural and urban bee keeping.

Now in its second year, the bee course has gone down well, with groups of students volunteering to manage individual hives throughout the year. It is hoped that following a small honey crop in the first year, this summer the bees will produce more honey, allowing analysis of some of the public health implications of this important food source.

As a result of the school's bee colonies, there has also been a fresh look at bee research.

Substances produced by honey bees, including propolis, honey, wax and venom, have been used for their medicinal properties throughout history, however it is honey that has been the primary focus of interest.

One of the many uses of honey is during the management of wounds in horses. In humans, research into the effects of honey has largely focused on its antimicrobial properties, which are attributed to many factors including acidity, hydrogen peroxide content, osmotic effect and phytochemical components. In addition to inhibiting microbial growth, these factors may also have a role in controlling inflammation and promoting the healing process through the modulation of cytokines, fibroblast proliferation and angiogenesis.

A variety of honeys are available, with differences in constitution and quality between types and even between batches. Some variation is due to the types of plants from which the nectar and pollen are collected by the bees, the country of origin and the method of production.

In veterinary practice the protocol for the use of honey on wounds varies. Some veterinary surgeons regularly buy inexpensive supermarket honeys, intended for human consumption, while others opt to use medical grade, gammairradiated manuka honey from New Zealand. This manuka honey is the most commonly used medicinal honey, and is produced by bees foraging manuka plants (*Leptospermum scoparium*). Manuka honey is believed to have superior antimicrobial properties due to factors other than hydrogen peroxide content, including some as yet poorly understood phytochemical property and/ or to the presence of methylglyoxal, which is derived from dihydroxyacetone in the nectar of the manuka flower. This nonperoxide property has been classified as the unique manuka factor (UMF) and is determined by comparison to a standard phenol concentration. This UMF is usually displayed on the honey jar.

Equine wounds

Equine wounds, particularly those involving the distal limbs, often undergo prolonged complex healing and may enter a non-healing state, with obvious implications for the welfare of the horse and the cost of treatment. Many factors lead to delayed wound healing, but among the most common is infection. Many of these chronic equine wounds heal by second intention and it has been suggested honey should allow for a better quality of wound repair as it stimulates the initial inflammatory response in leucocytes by increasing the production of cytokines that modulate fibroblast proliferation and angiogenesis. Some evidence suggests honey has a role in the removal of necrotic debris from wounds during the debridement phase of healing.

With an increase in cultures of antimicrobial-resistant bacteria, such as methicillin resistant S*taphylococcus aureus*(MRSA), from the wounds of human beings and horses, the potential value of bee products is more obvious than ever. To this end, a group including the author, who is an equine vet and amateur beekeeper, microbiologist Libby Graham and veterinary student Reagan Carnwath from the University of Glasgow investigated the antimicrobial effects of different types of

honey.

The aims were twofold – firstly, to determine if readily available, shop-bought honey was free from contamination and therefore safe for use on equine wounds, and secondly, to determine the effect of a number of types, sources and preparations of uncontaminated honey on the growth of bacteria commonly cultured from equine wounds.

Ten bacterial isolates were collected from the non-healing wounds of horses presented to the vet school's Weipers Centre Equine Hospital. These included *Staphylococcus aureus*, MRSA, *Escherichia coli*, *Streptococcus equi*subspecies *equi*, *S equ*i subspecies *zooepidemicus*, E*nterococcus faecalis*, *Acinetobacter baumannii*, methicillin– resistant *Staphylococcus epidermidis*(MRSE), *Staphylococcus sciuri*and *Pseudomonas aurigenosa*. Many of the bacteria isolated had resistant antimicrobial profiles.

Twenty-eight honeys were sourced from four supermarket brands, industrial wounddressing manufacturers, local beekeepers, the university hives and other samples from across the globe.

Each honey sample was checked for microbial contamination by streaking out on sheep blood agar. Of the 28 samples, 17 were contaminated, all four supermarket honeys were contaminated with *Bacillus*species, one was also contaminated with *E coli*. A Manuka 5+ was contaminated with *Bacillus*species. Many of the shop-bought mono-floral honeys (derived from bees foraging predominantly one type of plant) were also contaminated with *Bacillus*species including clover, orange and lime. One shop-bought honey was contaminated with *Proteus s*pecies. The uncontaminated honeys included all the medical grade honeys, Manuka 20+, Manuka 10+, local heather, shop-bought blossom, viper bugloss and Glasgow Floral Honey. The contaminated honeys were excluded from the second part of the study.

Each of the uncontaminated samples was serially diluted and incorporated into nutrient agar and poured into petri dishes. Samples of the 10 bacteria were inoculated on to the plates, which were then incubated. Any visible colony formation was recorded at the highest concentration of honey at which it was present. A minimum inhibitory concentration of honey was then recorded for each bacterium.

Unexpected results

The results were interesting and unexpected. Not surprisingly, medical grade manuka honey was effective at inhibiting all microbial growth at very low concentrations. However, similar results were noted for many of the local honey samples, with heather honey producing inhibition at concentrations below five per cent.

Perhaps most concerning was that a number of shopbought, non-medical grade honeys, produced by bees foraging a variety of nectar and pollen sources, may not be appropriate during wound care

due to the presence of contaminating microbes. Bacillus is a ubiquitous environmental organism and its presence is less of a concern than that of potentially damaging organisms such as E *coli*and Proteus species that were cultured from a number of the samples. Anecdotal evidence suggests some practitioners regularly use supermarket brand honey in the treatment of wound infections, but our study suggests this should probably be avoided.

Our findings indicate it may not be necessary to transport manuka from New Zealand when sources closer to home may be as effective – or even more effective. In many regions of the world access to expensive pharmaceuticals are limited and honey may provide a local, inexpensive alternative.

The concentrations at which the honey samples inhibited microbial growth were typically less than 20 per cent, much lower than is likely to occur at the surface of an infected wound treated with honey, even taking into account dilution by wound fluid and exudate. Work is required to determine the effect of honey on microbial growth in vivo.

Future work could allow identification of individual honeys with activity against specific bacteria that could be selected during wound treatment. The research continues and further results will follow as the vet school's bee colonies grow.

Acknowledgments

The author acknowledges the help of Kruuse UK, Georgie Hollis of the Veterinary Wound Library, Glasgow University Chancellor's Fund, and Evelyn and Neil Spence of Highland Bee Supplies.

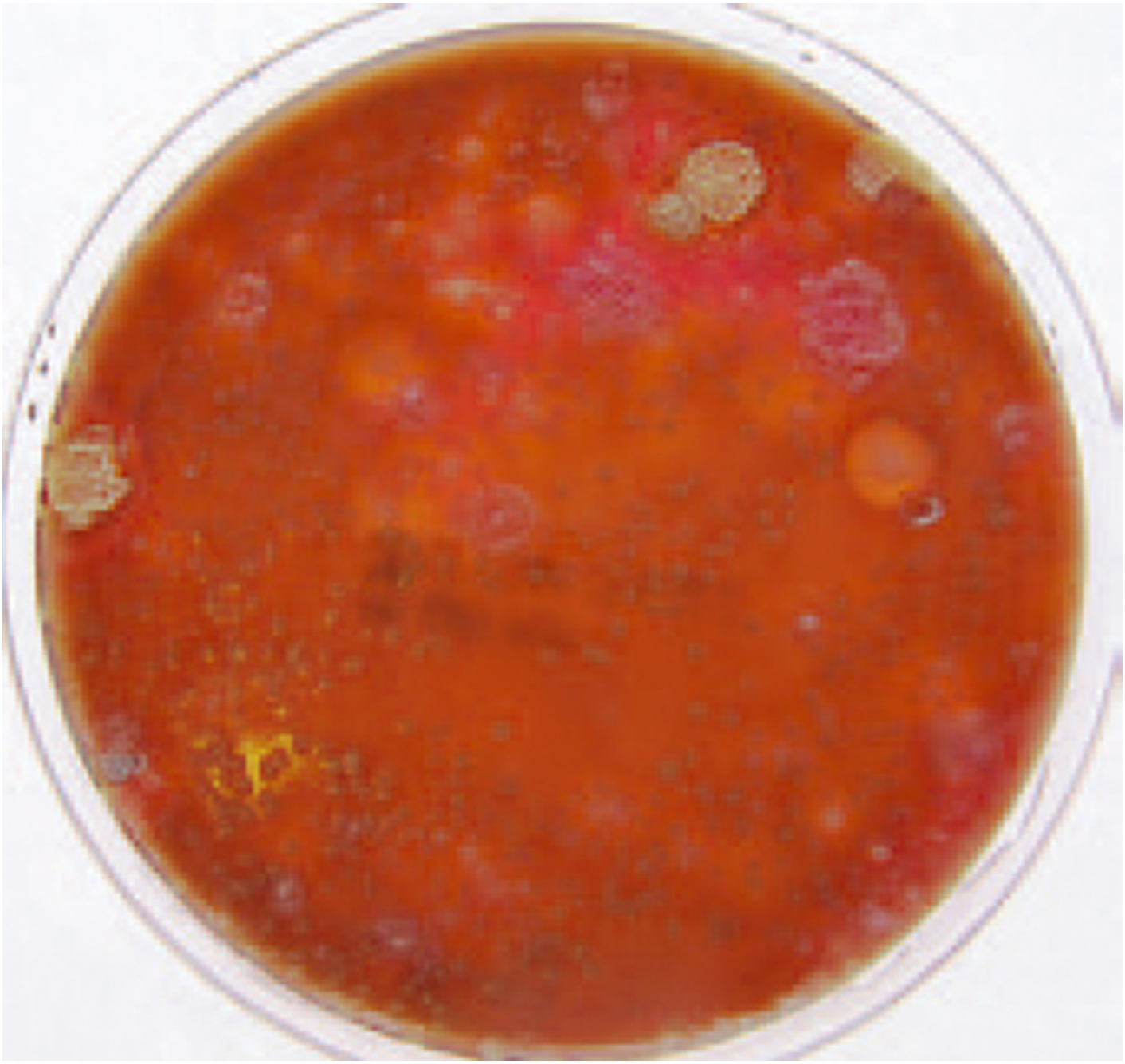
Further reading

Allen K L, Molan P C, Reid G M (1991). A survey of the antibacterial activity of some New Zealand honeys, J *Pharm Pharma* **43**: 817-822. Bischofberger A S, Dart C M, Perkins N R, Dart A J (2011). A preliminary study on the effects of manuka honey on second-intention healing of contaminated wounds on the distal aspect of the forelimbs of horses, *Vet Surg* **40**: 898-902. French V M, Cooper R A, Molan P C (2005). The antibacterial activity of honey against coagulase-negative staphylococci, *J Anti Chemo* **56**: 228-231. Hendrickson D A (2012). Management of superficial wounds. In Auer J A, Stick J A (eds) *Equine Surgery*. Elsevier, Missouri: 306-317.

A typical equine non-healing wound that could benefit from treatment with honey (left) and following one dressing change after the use of medical grade honey (right).

A typical equine non-healing wound that could benefit from treatment with honey (left) and following one dressing change after the use of medical grade honey (right).

Students working on the Glasgow hives.



Inset: an example of a contaminated honey sample.