



Development of an engineered honey (Surgihoney) as a novel topical treatment

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BACKGROUND

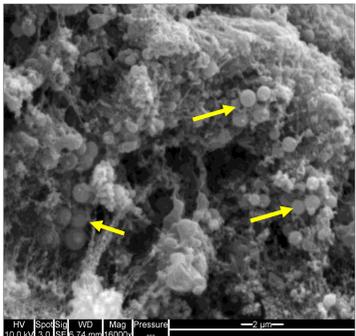
- The World Health Organisation's (WHO) 2014 report on global surveillance of antimicrobial resistance has revealed that the world has reached a **critical point**¹
- 1 in 5 of hospital-acquired infections are now attributed to Methicillin-resistant *Staphylococcus aureus* (MRSA)
- The Department of Health's annual report (2014 to 2015) of MRSA bacteraemia reported:
 - 874 community-acquired cases
 - 349 hospital-acquired cases

IMPACT ON NHS

- Delay of elective surgery
- Prolonged hospital stay
- Long-term antibiotic treatment

MUPIROCIN (Bactroban)

- Topical antibacterial treatment effective against Gram-positive bacteria, including MRSA, currently used as part of the decolonisation regime.
- Recent evidence indicates increasing resistance of MRSA to Mupirocin.^{2, 3}



BACTERIAL BIOFILMS

- Bacteria exist in 2 states - as planktonic free-floating microbes and within biofilms
- Biofilms are defined as structured and antibiotic-tolerant bacterial aggregates
- Difficult to culture, identify, diagnose, and treat
- Implicated in chronically infected wounds

FIGURE 1. SEM image (Mag x 16000) demonstrating surface-related *S.aureus* biofilms (yellow arrows) on the sinonasal mucosa of a patient suffering with chronic rhinosinusitis (Image courtesy of Mr Stephen Hayes)

SURGIHONEY

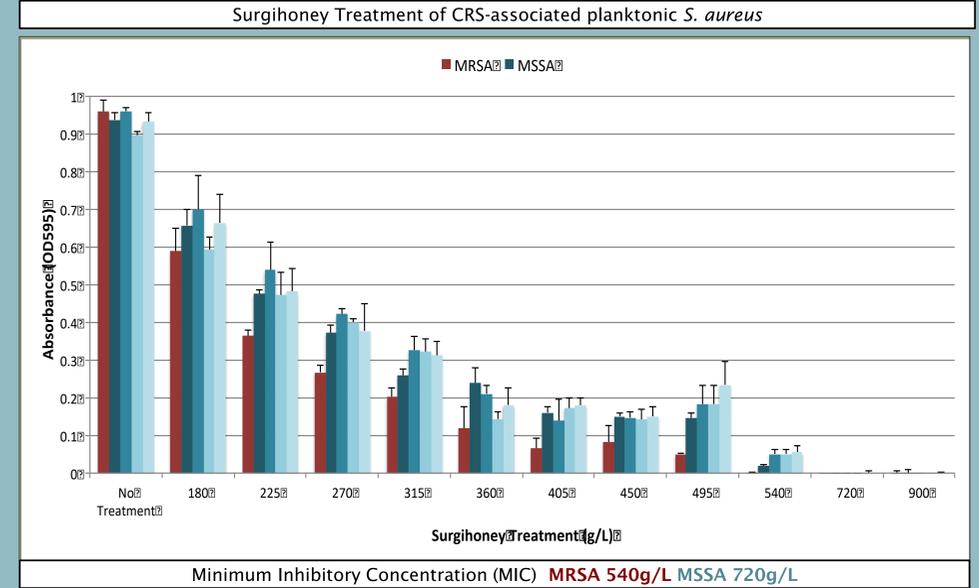
- Novel engineered organic honey product which releases controllable reactive oxygen species as key mediator
- Possesses potent anti-microbial properties
- Demonstrated to be highly effective in topical treatment of chronic wounds



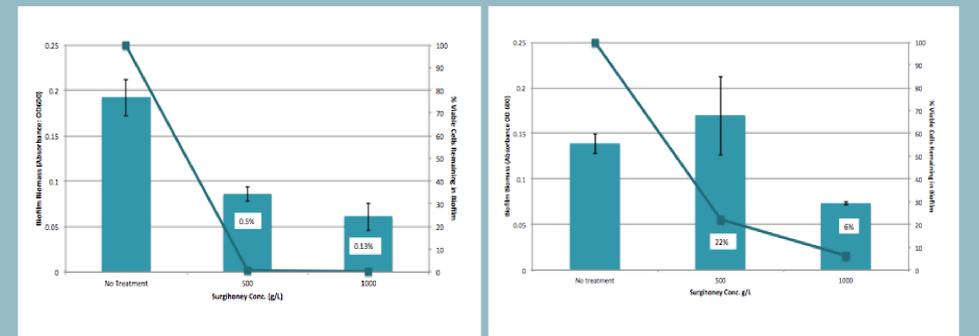
FIGURE 2. A 77 year-old male with peripheral vascular disease developed long standing ischaemic ulcers chronically infected with *Pseudomonas aeruginosa* (A). After a 7 day treatment with Surgihoney a significant clinical improvement was seen (B). (Picture courtesy of Dr Matthew Dryden)

PRELIMINARY WORK

- An *in vitro* study was undertaken using bacterial isolates obtained from the sinonasal cavities of patients suffering with chronic rhinosinusitis (CRS). Preliminary results have demonstrated potent bactericidal and inhibitory effects of Surgihoney on MRSA and Methicillin-sensitive *Staphylococcus aureus* (MSSA) in both planktonic and biofilm forms (**Figures 3&4**)



FIGURES 3 & 4. A dose dependent reduction of MRSA and MSSA biomass is demonstrated following the use of Surgihoney. A minimum bactericidal concentration (MBC) was achieved as shown below.



FIGURES 5 & 6. *In vitro* MRSA and MSSA static biofilms were initially grown and then treated with Surgihoney. A 99.5% and 99.87% reduction of MRSA biofilm colony forming units following Surgihoney treatment at a concentration of 500 and 1000g/L respectively was noted. A 78% and 94% reduction was demonstrated at similar concentrations following MSSA biofilm Surgihoney treatment.

AIMS

1. To compare the efficacy of Surgihoney versus Mupirocin on MRSA isolates in the *in vitro* setting.
2. To conduct a small scale proof-of-principle clinical study examining the feasibility of using Surgihoney as a novel MRSA decolonisation therapy in MRSA-positive clinical subjects.

METHODOLOGY

Recruitment and phenotyping of clinical subjects

Patients identified as MRSA carriers as a result of pre-assessment screening will be recruited into the study.

Specimen acquisition, isolation of MRSA and *in vitro* bacterial analysis

The antimicrobial activity of Surgihoney will be assessed *in vitro* on both planktonic and biofilm MRSA phenotypes. The bactericidal and inhibitory function of Surgihoney will be compared to current standard therapy (Mupirocin).

Proof of principle clinical study

A small scale proof of principle clinical study will be conducted to assess the feasibility of using Surgihoney as a novel MRSA decolonisation therapy in the nasal cavity.

TRANSLATIONAL / FUTURE AIM

- Using the results from this study will help to translate this science into the clinical setting by using it as a topical therapy in MRSA nasal carriers and surgical patients with MRSA-infected wounds.

ENVIRONMENT

The 2014 national assessment of research (Research Excellence Framework), described the University of Southampton as having the following:

- Over 97% of the University's research environment has been assessed as world-leading and internationally excellent
- 84+ world-class research facilities
- Chosen by more than 150 different businesses for research and development
- Three Southampton Professors awarded Wolfson merit awards in 2014.

SOUTHAMPTON UPPER AIRWAY RESEARCH GROUP

- The Head of the Upper Airway Research Group, Mr Rami Salib, has been accredited with several Royal College of Surgeons' of England awards including:
 - Louis Alexander Fellowship (2001)
 - Frances and Augustus Newman Award (2002)
 - RCSEng Pump-priming award for newly-appointed Senior Lecturers (2006)
 - Hunterian Professorship of Surgery (2008)
- Mr Stephen Hayes, Rhinology Research Fellow, was awarded the RCSEng One-Year Surgical Research Fellowship in 2011.

REFERENCES

1. World Health Organisation Antimicrobial Factsheet (No. 194, Updated April 2014). Accessed on 19th February 2015
2. Jones J, Rogers T, Brookmeyer P, Dunne W, Storch G, Coopersmith C et al. Mupirocin Resistance in Patients Colonized with Methicillin-Resistant *Staphylococcus aureus* in a Surgical Intensive Care Unit. *Clinical Infectious Diseases*. 2007;45(5):541-547.
3. Patel J, Gorwitz R, Jernigan J. Mupirocin Resistance. *Clinical Infectious Diseases*. 2009;49(6):935-941.