Background

P. aeruginosa, S. aureus and C. albicans are common wound pathogens and products are often assessed against them individually. However, in nature they do not exist in isolation. The presence of a microorganism in a culture can alter the behaviour of other microorganisms present. For example, growth of C. albicans with P. aeruginosa in a multi-species biofilm has been shown to increase the expression of P. aeruginosa virulence factors such as pyoverdine, rhamnolipids and pyocyanin compared to monocultures. Single species biofilm models mimic the real-world scenario considerably more than planktonic assessments, however the use of multi-species biofilm models adds additional complexity to bridge the gap between in vitro models and clinical testing. Multi-species biofilm infections can complicate or delay wound healing and effective treatment can aid healing.

Aim

To determine the biofilm disruption capabilities of two wound care products using a mixed species colony drip flow model.

Methodology

- **P. aeruginosa, S. aureus and C. albicans** were prepared in a bespoke growth medium.
- A Drip Flow Reactor (DFR) was prepared with hydrated, multi-layered coupons.
- The multi-species inoculum was circulated through the DFR at 5 ml/hr at 37°C for 72 hours to establish mature biofilms (Figure 1).
- Following incubation, coupons were rinsed in Phosphate Buffered Saline (PBS) to remove planktonic organisms.
- Coupons were transferred to a bioengineered medical honey wound gel* or sandwiched between Cadexomer iodine** dressings for 24 hours at 37°C (Figure 2).
- Following treatment, coupons were rinsed in PBS, placed in neutraliser and sonicated to recover remaining attached microorganisms. The resulting suspension was enumerated.

![Figure 1. A photograph of pre-formed multi-species biofilms in a drip flow reactor.](image)

![Figure 2. A photograph of biofilm surfaces during treatment. A = Negative Control, B = bioengineered medical honey wound gel* C = Cadexomer iodine**](image)

Results

No viable P. aeruginosa or S. aureus were recovered from coupons following treatment for 24 hours with a bioengineered medical honey wound gel or a Cadexomer iodine dressing. An average of 5.82 Log_{10}cfuml^{-1} P. aeruginosa and 2.13 Log_{10}cfuml^{-1} S. aureus were recovered from the control following 72-hours incubation. No C. albicans were recovered from the control or treated coupons which was expected from this model (Figure 3).

![Figure 3. Quantity of *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Candida albicans* recovered from porous surfaces containing multi-species biofilms following treatment.](image)

Discussion and conclusions

Biofilms have been shown to be present in approximately 70% of chronic wounds where they reduce healing times. Single species biofilm models are typically used to test products. However, clinical biofilms are more likely to be composed of a number of microorganisms rather than a single species. The model used in this study utilised bacteria and fungi commonly found in chronic wounds to develop an infected wound model that is relevant to a clinical environment.

The study showed that following treatment with a bioengineered medical honey wound gel and a Cadexomer iodine dressing, no viable organisms were recovered from coupons containing pre-formed 72-hour mixed species biofilms. This suggests that both treatments were comparable as they could both treat pre-formed biofilms. Products with anti-biofilm capabilities could have useful clinical implications. Clinical studies would be required to confirm this result.

References


* = Surgihoney™ RO® sterile medical honey
** = Iodoflex cadexomer dressing with iodine

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