The $94 Billion Problem: Application of Safe Acid Technology (SAT) to Combat Biofilm Infections

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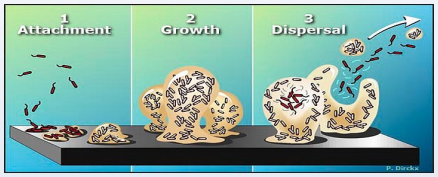
Biofilm Establishment and Proliferation



INTRODUCTION

Biofilm infections present a major public health threat. In the United States alone, biofilm infections are implicated in up to 550,000 yearly fatalities with an estimated annual cost of $94 billion[1,2]. Biofilm infections are difficult to treat, as biofilm-secreting bacteria are highly resistant to host immune responses. We hypothesize that Safe Acid Technology (SAT), a unique acid formulation, may reduce the risk of biofilm infections while maximizing patient safety.

METHODS & MATERIALS

Anti-biofilm testing was administered by the Montana State University Center for BioFilm Engineering using a single species (*Pseudomonas aeruginosa*) biofilm grown in the CDC reactor according to ASTM E2871-12 on polycarbonate coupons. After establishing biofilms, the polycarbonate coupons were exposed to SAT formulations for multiple exposure times in varied concentrations.

Table 1. Treatment Matrix

Treatment	Contact time
C0400	30 minutes
C0200	30 minutes
C0200	10 minutes
C0100	30 minutes
C0100	10 minutes
C0050	30 minutes
C0025	30 minutes

CDC Reactor

RESULTS

Log reductions of biofilm ranged from 3.61 at concentrations of C50 to 4.82 at C25. This was compared to biofilm concentration of Log 8.62 on control

Formulation	Titration (pH)	Mean Log (CFU/cm²)	SD	Log Reduction
Control	--	8.62	0.02	N/A
For Contact Time of 30 min				
C0400	0.35	4.21	1.21	4.41
C0200	0.65	4.51	2.13	4.11
C0100	0.90	4.17	1.09	4.45
C0050	1.20	5.01	1.73	3.61
C0025	1.60	3.80	1.69	4.82
For Contact Time of 10 min				
C0200	0.65	4.66	1.58	3.95
C0100	0.90	4.28	0.84	4.34

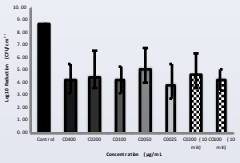


Fig 1. Results of Treatments (error bars are ± 1 SD from the mean).

CONCLUSION

The current recommended treatment for biofilm infections involves long-term antibiotic therapy, which may reduce bacteria in the perioperative period but has limited ability to address bacterial resistance and penetrate biofilms. Safe Acid Technology, which demonstrates potent anti-biofilm action along with non-toxicity to human mucosa, may prove a superior and cost-effective alternative to the current treatment paradigm for biofilm infections.

REFERENCES

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DISCUSSION

Despite Safe Acid Technology's disinfectant power, it does not irritate or harm human skin or mucosa. SAT has passed the EPA's stringent toxic six-pack criteria assessing toxicity and irritation to human skin. Additionally, all of SAT's ingredients are listed on the FDA's "generally recognized as safe" list. There is no special disposal protocol necessary for SAT as it breaks down into harmless inorganic compounds and is nontoxic. The combination of extreme acidification and non-toxicity opens the possibility of a wide range of applications for Safe Acid Technology including:

Fig 2 (Pupp G, Koivunen R. How to Assess the Bacterial Burden of DFUs. *Pod Today 2012;62-68*

Fig 3 (Pupp G, Koivunen R. How to Assess the Bacterial Burden of DFUs. *Pod Today 2012;62-68*

Fig 4 (Adapted from Wipf et al, 2008.[5])

WOUND CARE

- Wound healing is a complex physiological process. The presence of biofilms and infectious agents in these wounds can be catastrophic. The surface pH of a wound has been demonstrated to influence wound healing, as it helps control infection in addition to increasing antimicrobial activity, oxygen release, angiogenesis, protease activity, and bacterial toxicity[3]. SAT could be applied to wounds to achieve a sterile environment ideal for healing while avoiding harm to patient tissues.
- Additionally, SAT has demonstrated up to a seven log reduction (99.9999999%) in the five most commonly isolated bacterial species in chronic wounds (*Staphylococcus aureus, Enterococcus faecalis, Pseudomonas aeruginosa*, coagulase-negative Staphylococci, and *Proteus* species)[5]. SAT could be used in a chronic setting in conjunction with normal wound care and dressing changes.

PRE-OPERATIVE SKIN ANTISEPTIC

- Biofilms are well-adapted to growth on all physiological tissues, as well as implantable and injectable materials. In a surgical setting, these infections are often devastating. The current standard of care for prophylactic surgical skin prep includes topical application chlorohexidine gluconate and iodine[7]. The latter of which has been shown to be inactivated by exposure to blood and serum[6]. Chlorohexidine gluconate has been shown to be unsafe for ears, eyes, and mouth, and may not be used for preparation of facial procedures. In contrast, SAT has been shown to be safe on all mucous membranes including ear, mouth, and eye membranes.
- Safe Acid Technology could be used as a pre-operative skin antiseptic to minimize peri-operative surgical site infections.