POLYQUATERNIUM-1 AND RHAMNOLIPIDS FOR BIOFILM CONTROL AND HEALING IN CHRONIC WOUND MODELS

The Challenge: Biofilm-mediated persistent infections sustain inflammation, increase antimicrobial tolerance, and disrupt repair signaling resulting in stalled chronic wound closure.

The Gap: An unmet need persists for host-compatible biofilm control that supports healing while targeting clinically relevant wound pathogens, including MRSA and P. aeruginosa.

Our Approach: Polyquaternium-1 (PQ-1) and fermentation-derived rhamnolipids (RL) deliver multifunctional complementary mechanisms of action. Rapid antibiofilm control with pro-healing support validated through in vitro biofilm and fibroblast assays and in vivo obese diabetic wound model causing impaired healing function with prescribed subset implanted with MRSA biofilm.

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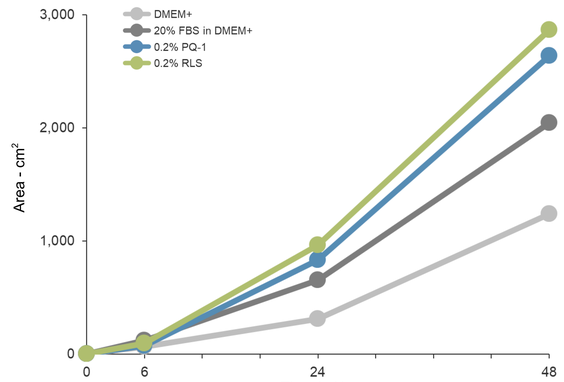
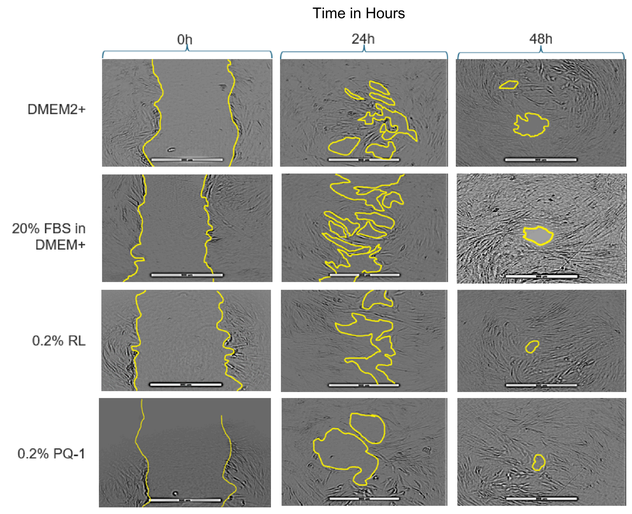
✓ Promotes Fibroblast Migration

PQ-1 and RL improve wound closure and closure rate over both negative and positive controls at 0.2%.



Increased AUC integrates faster closure kinetics with greater total wound infill over time

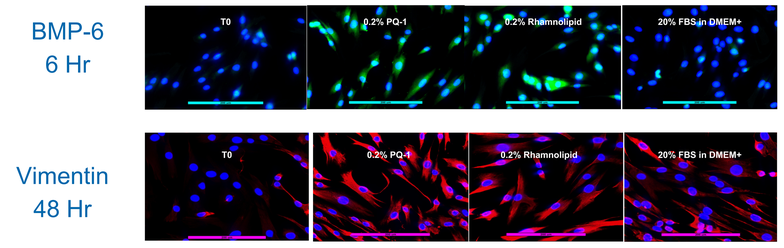


Method

Human dermal fibroblasts were seeded in 12-well plates and grown to ~90% confluence (N=3/Treatment). A linear scratch was made using a sterile pipette tip, followed by treatment with control or test formulations in DMEM2+. Cultures were incubated under standard conditions for 48 ± 2 hr to assess cell migration and wound closure.

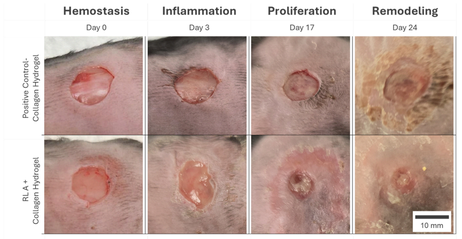
✓ Enhanced Wound Healing Protein Expression

RL broadly upregulates wound-repair markers, while PQ-1 selectively increases vimentin during repair.

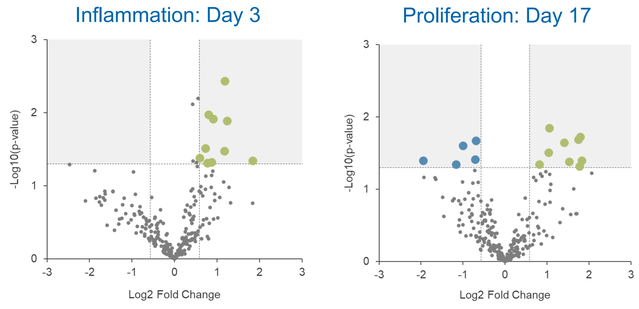


✓ In vivo Improvement of Wound Healing Observed

RL reduces time to closure and improved wound-bed quality compared with control



RL beneficially modulates wound healing genes, regulating key areas: inflammation, angiogenesis, and cellular proliferation.

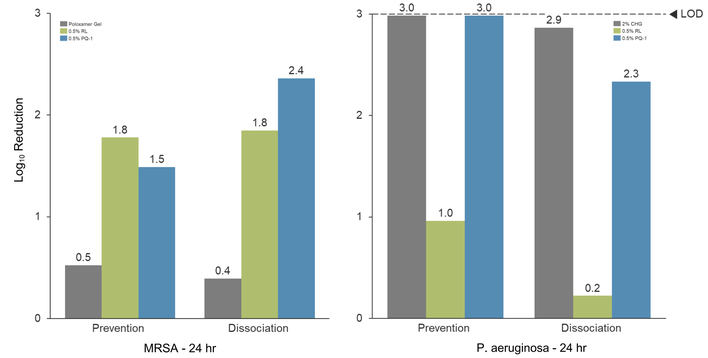


Method:

Diabetic, obese, male mice with 10mm punch biopsy. Treated with 1% rhamnolipid in collagen hydrogel and covered with dressing at indicated time point. NanoString samples collected at Day 3 and Day 17.

✓Demonstrates Infection Control

Dual-Action Biofilm Control: Prevention and Disruption by PQ-1 and RL

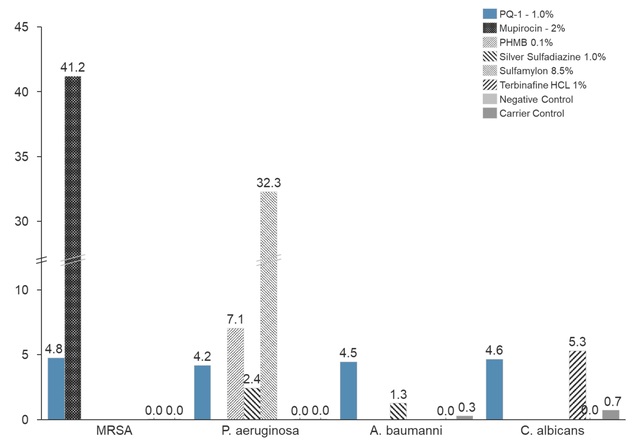


Method

Prototypes were tested against MRSA and PA biofilms using the Calgary Biofilm Device. Test solutions were applied for 24 hr to assess both prevention and disruption. Biofilms were analyzed by flow cytometry and stained with crystal violet to highlight biofilm.

PQ-1 Demonstrates in vitro Broad-Spectrum Efficacy

Zone of Inhibition



Method:

Agar diffusion plates of TSA with 5% sheep's blood. 10mm punch. 200µl test substance incubated for 24hrs at 37°C and measured using planimetry method.

Conclusion

PQ-1 and rhamnolipids induced an early pro-repair fibroblast response in a scratch-wound model, increasing BMP-6 and vimentin expression and improving both infill kinetics and total infill. In vivo, rhamnolipids enhanced wound healing versus a commercial comparator, supported by NanoString-based increases in repair-associated markers. Together with demonstrated antibiofilm activity for both agents and broad-spectrum antimicrobial performance demonstrated through both in vitro and in vivo efficacy results for PQ-1 support continued development of a dual-function approach integrating host repair modulation with microbial/biofilm control.

Next Steps

No antagonism was observed in early antimicrobial interaction studies, and both rhamnolipids and PQ-1 were readily formulated in collagen hydrogels, supporting feasibility for topical delivery. Next studies will define dose–response and temporal marker dynamics, validate complementarity in mature/mixed biofilm systems, and confirm efficacy in clinically relevant in vivo wound models, including infected and biofilm-burdened settings.