Antimicrobial effects of purified sophorolipids congeners on pathogenic skin bacteria

Antimicrobial effects of purified sophorolipid congeners on pathogenic skin bacteria

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Background

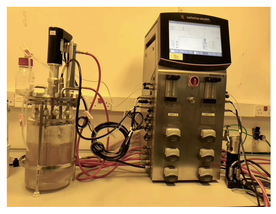
The majority of pathogens associated with skin infections have developed resistance to antibiotics due to their overuse, hence, the need for novel and more effective antimicrobial agents.

Microbial sophorolipids are well–known antimicrobial agents. However, most studies on the antimicrobial effects of sophorolipids were determined using their crude mixtures and poorly characterized congeners, resulting in significant interstudy variations, which are difficult to interpret. Therefore, to broaden the potential applications of sophorolipids and make them attractive for use as effective antimicrobial agents, highly purified and properly characterized congeners of sophorolipids were utilized in this study.

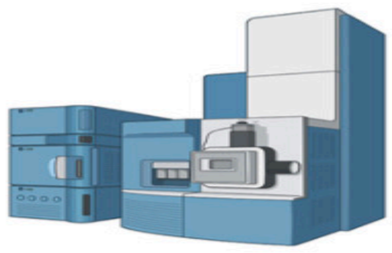
Aim

To assess the antimicrobial effects of highly purified Acidic sophorolipids (ASL) and Lactonic sophorolipids (LSL) on *Staphylococcus aureus* ATCC 29213, *Cutibacterium acnes* DSM 1897, and *Streptococcus pyogenes* ATCC 19615 in comparison with synthetic sodium lauryl ether sulphate (SLES) commonly used in skincare products

Methods

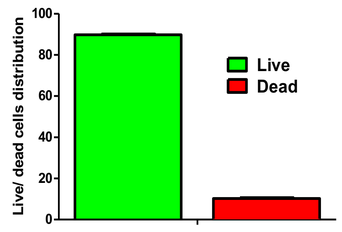


Sophorolipids production



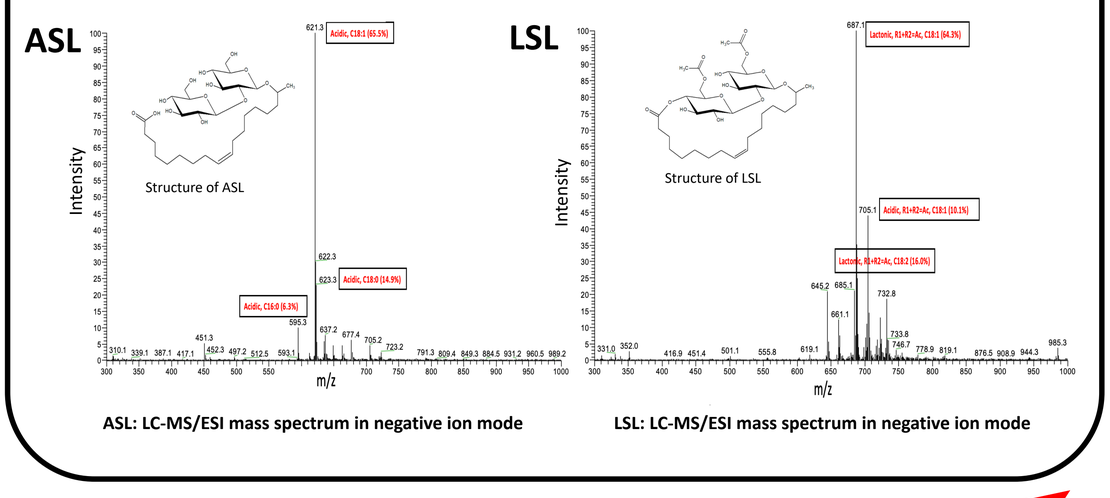
Sophorolipids characterization using HPLC/MS-ESI

Broth microdilution assays followed by MTT assay



Live/dead cells assessment via acridine orange and propidium (AO/PI) staining

Purity of sophorolipids (ASL: 100%; LSL: 90%)



ASL: LC-MS/ESI mass spectrum in negative ion mode **LSL: LC-MS/ESI mass spectrum in negative ion mode**

Figure 1. HPLC–MS/ESI profile of ASL with predominant congener Acidic, C18:1 (65.5%) and LSL with predominant congener Lactonic, R1 + R2 = Ac, C18:1 (64.3%). This analysis show that ASL was 100 % pure and LSL was 90 % pure.

Low concentrations of LSL significantly reduce the viability of pathogenic skin bacteria

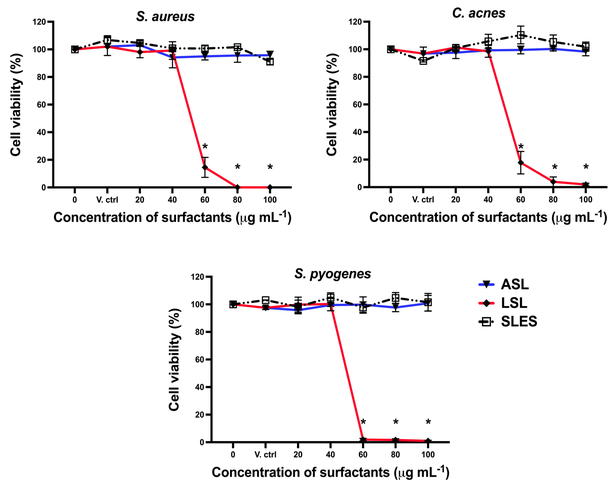
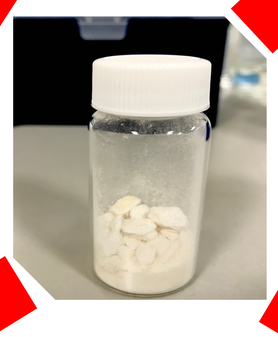


Figure 2. The effects on of ASL, LSL and SLES on the viability of *S. aureus*, *C. acnes*, and *S. pyogenes* post 24 hrs treatment at 0 – 100 μg mL^{-1}. Data are the mean results of three independent experiments. Error bars represent standard error from the mean. Statistical significance was determined using a one-way ANOVA followed by Dunnett's Multiple Comparison Test. * = $p < 0.05$



Purified sophorolipids extract

Treatments with LSL drastically reduce cell population

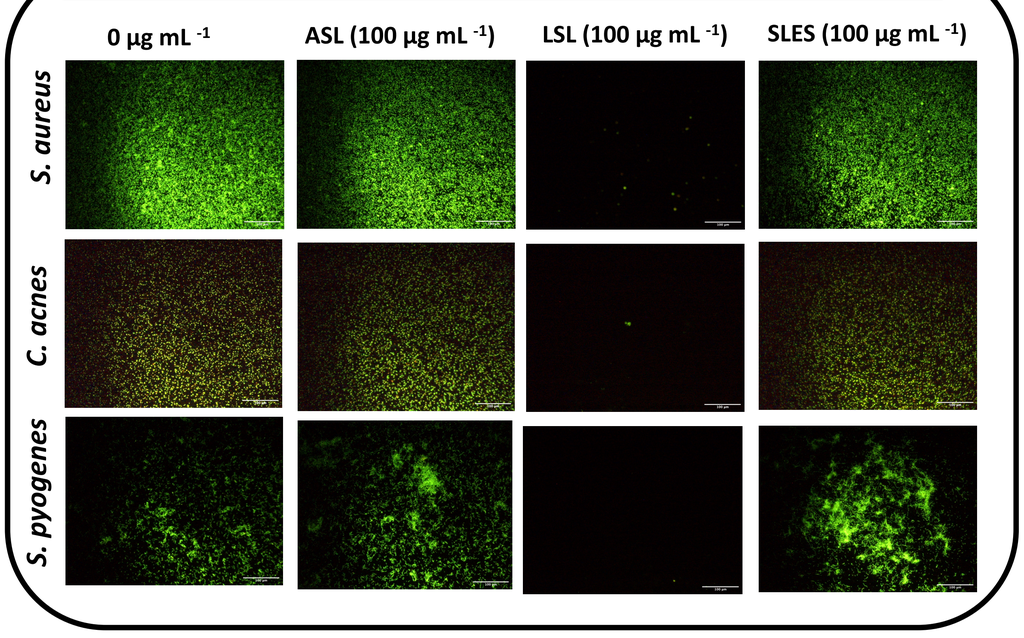


Figure 3. The use of AO/PI staining to assess the effects of surfactants on the morphology of pathogenic skin bacteria. *S. aureus*, *C. acnes*, and *S. pyogenes* were either untreated (0 μg mL^{-1}) or treated with ASL, LSL and SLES at 100 μg for 24 hrs. The vast majority of cells in untreated, ASL and SLES treatment groups were morphologically viable (stained green) while cells treated with LSL resulted in significant reduction in cell population. Scale bar is set at 100 μm

The interaction of sophorolipids' acetyl groups with cell membrane facilitates antimicrobial effects

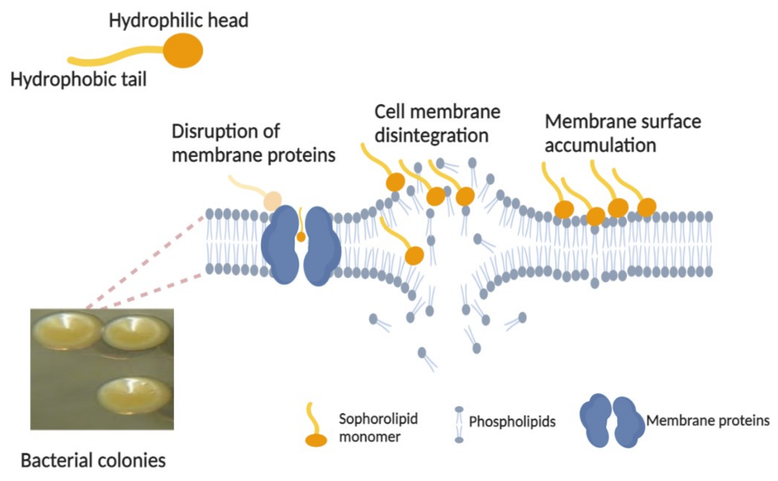


Figure 4. Theoretical interaction of sophorolipids with membrane of pathogenic skin bacteria. The antimicrobial efficacy of sophorolipids is hypothesised to be dependent on their degree of acetylation and saturation of fatty acid group. The comparatively higher antimicrobial effects of LSL is often attributed to their high level of acetylation (diacetylated) and fatty acids saturation.

Conclusion

Purified sophorolipid congeners have been demonstrated to have differing effects on pathogenic skin bacteria dependent on chemical structure.

While ASL and SLES had no significant effects on viability and and morphology of the skin pathogens under study, LSL were demonstrated to have inhibitory effects at concentrations as low as 60 μg mL^{-1}. Thus, as effective antimicrobial agents, LSL could be incorporated into topical skincare formulations to "fight" *C. acnes*, *S. aureus*, and *S. pyogenes*, which are the leading cause of acne vulgaris, atopic dermatitis, and impetigo, respectively.

Acknowledgements

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