Antimicrobial effects of freshwater sponge extracts from laboratory grown and riverine sponges

Allison Cartwright, Joerg Arnscheidt, James Dooley, Chris McGonigle
Ulster University, Coleraine
Contact: Cartwright-A4@ulster.ac.uk
Funder: Department of Education

Introduction

- Freshwater sponges are filter feeding organisms found in rivers and lakes.
- There are two common species in Ireland, Ephydatia fluviatilis and Spongilla lacustris.
- Freshwater sponges are seasonal and die back into seed-like structures called gemmules during the winter, from which they hatch again in spring.
- Previously it has been demonstrated that marine sponges contain antimicrobials, but it was unclear whether these properties were from the sponge or their microbioms.
- Riverine sponges exist with site specific microbial communities; in comparison microbial diversity is much lower in sponges which have been laboratory grown from gemmules allowing for the contribution of the microbiome for antimicrobials to be investigated.

Figure 1: The freshwater sponge Ephydatia fluviatilis (left) and gemmule structure (right) including a hatching sponge

Figure 2: Methanol extracts of different sponges (left) and an example of a disc diffusion assay of sponge extract to determine the strength of antimicrobial properties (right)

Methods

- The antimicrobial properties of E. fluviatilis and S. lacustris extracts were determined in a series of laboratory assays.
- Sponges of each species were collected from rivers (natural site specific microbiome) and laboratory grown in sterile water (low diversity microbiome).
- Sponge samples were dried and extracted in methanol.
- After evaporation of methanol, extracts were resuspended in DMSO.
- Antimicrobial properties were assessed by disc diffusion and recording of the minimal inhibitory zone (MIZ).
- The extracts were tested against the healthcare associated bacteria Acinetobacter baumannii, Escherichia coli, Enterococcus faecalis, Klebsiella pneumoniae, Pseudomonas aeruginosa, Staphylococcus aureus and Staphylococcus epidermidis.

Figure 3: Arithmetic means and standard error values for the maximum inhibitory zone (MIZ) of bacterial growth around diffusion discs for laboratory grown and riverine sponges. SLG – laboratory S. lacustris, SLA – riverine S. lacustris, EFG – laboratory E. fluviatilis and EFA – riverine E. fluviatilis. Different letters represent a significant difference in pairwise comparisons with Mann Whitney U tests (p<0.05).

Figure 3 a-c indicated antimicrobial properties from the sponge microbiome.
Figure 3 d indicated antimicrobial properties against K. pneumoniae from the sponge cells themselves.

Results

- None of the tested sponge extracts suppressed the growth of P. aeruginosa, S. aureus or S. epidermidis.
- Only K. pneumoniae was inhibited by all extracts, with the extracts from laboratory grown sponges resulting in significantly wider MIZs (U=73, 89, p=0.004-0.019).
- A. baumannii, E. coli and E. faecalis were only inhibited by the extract from riverine S. lacustris.

- The above results indicated that freshwater sponges and their microbiome can provide effective antimicrobial effects against selected bacterial strains.

Conclusions

- Freshwater sponges are potential sources of antimicrobial compounds, particularly against K. pneumoniae.
- Inhibition of K. pneumoniae by riverine and laboratory grown sponges suggested that this effect originated from sponge cells themselves.
- The stronger antimicrobial effect of riverine S. lacustris against A. baumannii, E. coli and E. faecalis indicated a contribution of the sponge microbiome to inhibition efficacy.

References