

Aims of study

Aims

- To isolate and curate *Actinomycetes* from Atacama desert soil samples
- To demonstrate that these *Actinomycetes* are taxonomically novel
- To test the metabolites produced by these isolates for antibiotic properties

Background

In the past *Actinobacteria* have been used to produce many antibiotic compounds, but the rise of superbugs such as MRSA and bacteria resistant to traditional antibiotics, means we must find antibiotics with novel mechanisms of action.

Searching for these new metabolites using well known *Actinomycetes* often leads to the re-discovery of the same compounds and is economically unfeasible.

The search for new antibiotics with novel mechanisms of action has therefore been taken to extreme or unusual environments. Organisms that can survive these conditions have adapted their physiology and biochemistry and so it follows that the secondary metabolites they produce are often novel.

The Atacama desert, one of the world's oldest and driest deserts, is a good example of an extreme environment that may harbour interesting and useful organisms.

Figures 1-3 (right): The Atacama Desert, located in northern Chile, covers over 100,000km². It is the driest non-polar desert in the world, receiving an average annual rainfall of 10.5cm¹.



Materials and methods

Selective Isolation

- Soil samples were taken from the surface (2cm) and sub-surface (30cm) of sites 3018, 4000 and 5046 metres above sea level.
- The samples were heat treated at 120°C for 20 minutes and 0.1g of each sample was sprinkled over agar plates of 6 different selective media.
- After incubation at 37°C for one week individual actinomycete colonies were isolated and purified onto ISP3 media.



Figure 4 and 5 (left): Isolated actinomycete colonies producing coloured pigments on ISP 2 media

Colour Grouping

The isolates were sorted into groups based on the colour they produced on ISP3 media. This has previously been shown to correlate with polyphasic taxonomic classification.

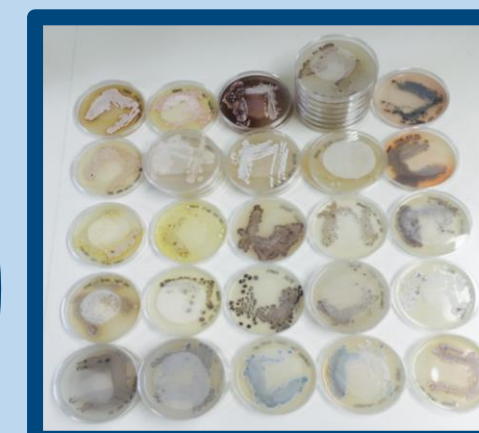
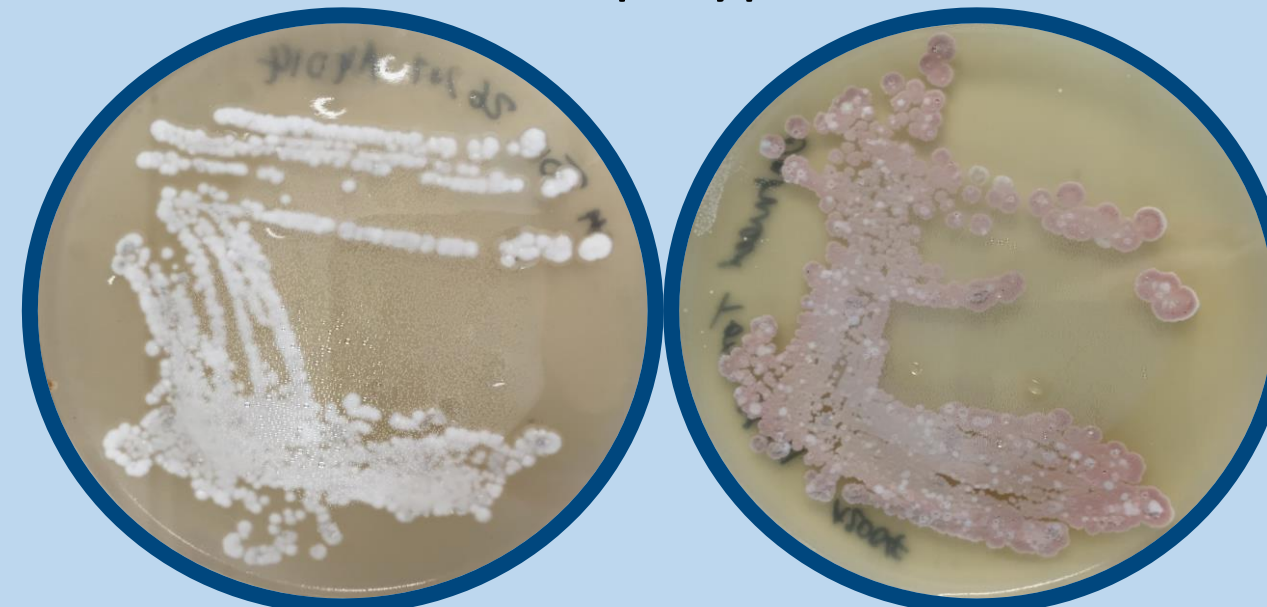


Figure 6 (left): The 25 different colour groups, figures 7-9 (inset left and above): examples of the pigments produced on ISP3 media

Plug assays – Antibiotic characteristics!

Plugs of the key strains were incubated on bacterial lawns of *E.coli*, *Pseudomonas fluorescens*, *M. luteus* and *Bacillus subtilis* for 3 days at 37°C. Zones of inhibition were recorded. Many of the isolates showed antibiotic properties against these bacteria.

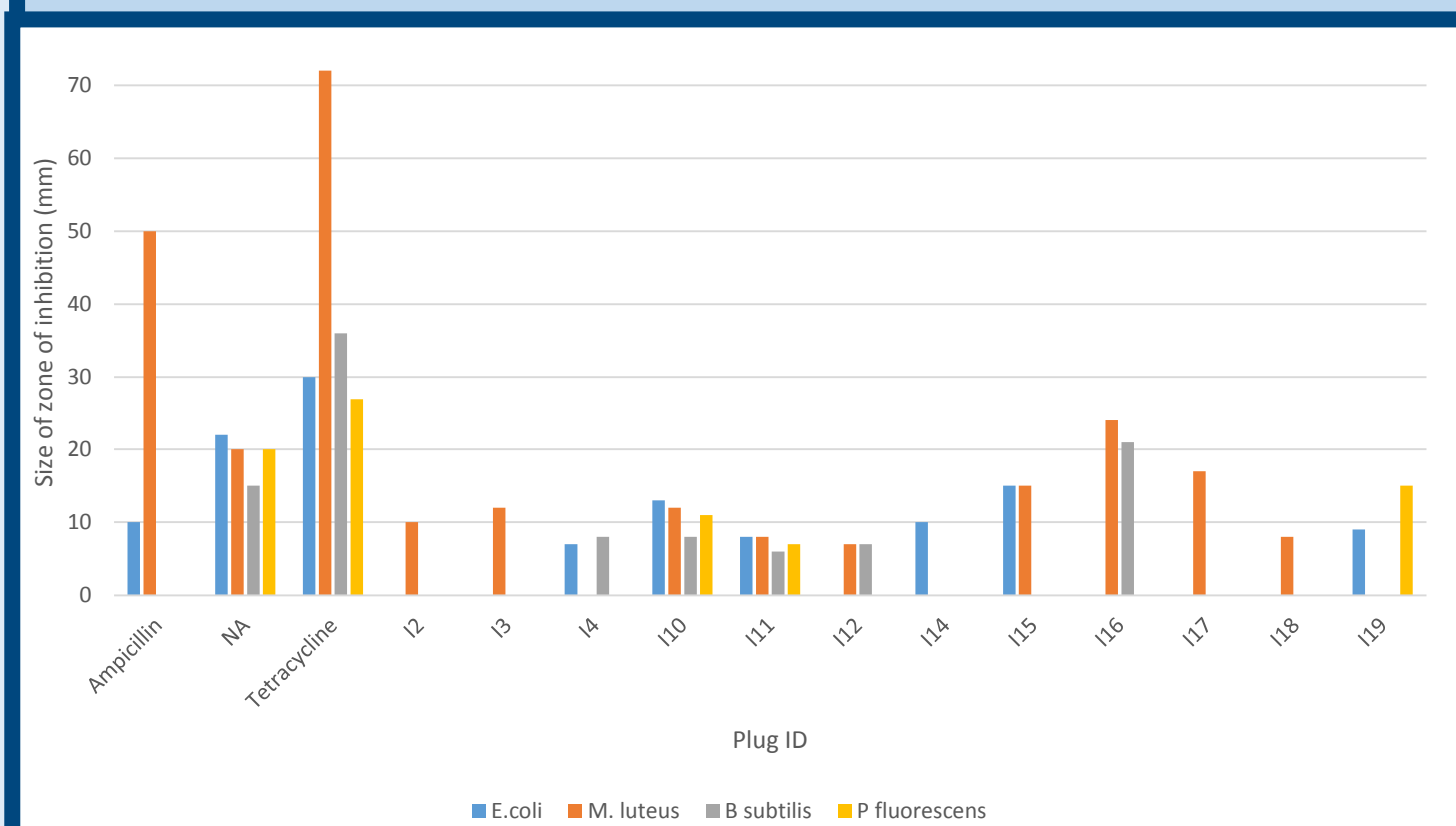


Figure 10 (left): Many of the isolates showed antibiotic characteristics, although the zones of inhibition were smaller than the positive controls in most cases.

Results and Conclusions

16S rRNA gene sequencing

16S rRNA sequences extracted from the isolates were analysed and a phylogenetic tree constructed showing how the strains are related.

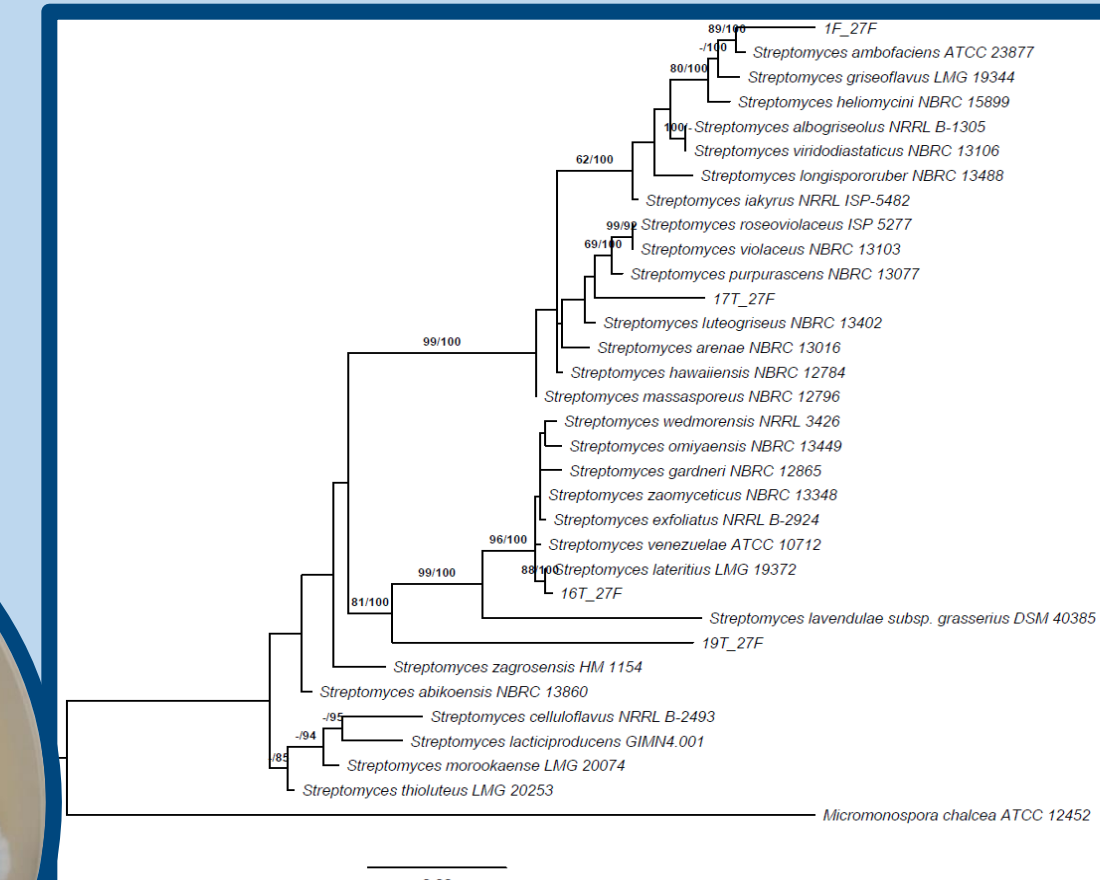


Figure 11 (left): A phylogenetic tree showing isolates 1, 17, 16 and 19 with the type strains of their closest relatives in the *Streptomyces* genus.

Scanning Electron Microscopy (SEM)

6 of the isolates were chosen for curation on scanning electron microscope slides. These can be viewed by using the QR code below.

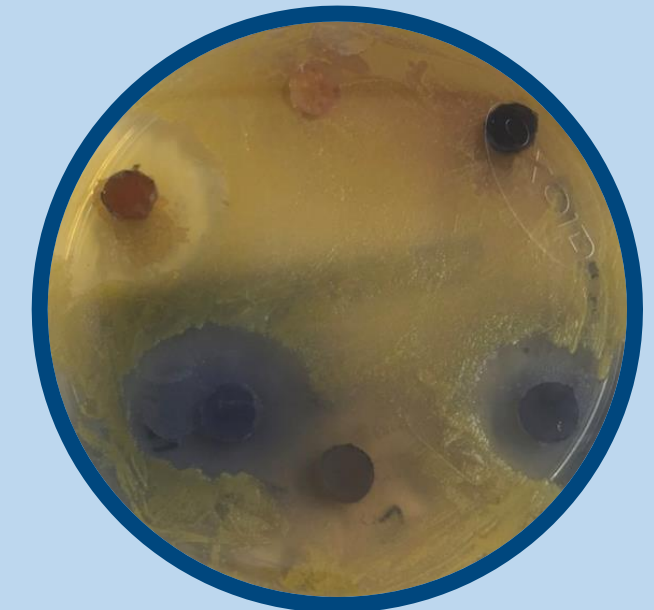
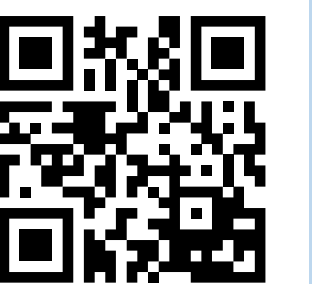


Figure 12 (right): Zones of inhibition can be seen around the plugs. Figure 13 (far right): QR code for photos of the SEM slides.



Conclusions

- A highly diverse range of *Actinomycetes* can be isolated from soil in the Atacama desert
- Taxonomically novel *Actinomycetes* were isolated from the Atacama soil samples
- The metabolites produced by the isolates had antibiotic characteristics

Acknowledgements

- Goodfellow and Fiedler (2010) A guide to successful bioprospecting: informed by actinobacterial systematics. *Antonie van Leeuwenhoek* 98:119-142
- With help from Imen Nouioui in creating the 16S rRNA tree.
- 1) - <http://www.ucmp.berkeley.edu/exhibits/biomes/deserts.php>
- Atacama images taken from: <http://bit.ly/2dWBq3c>, stock images and https://en.wikipedia.org/wiki/Atacama_Desert (created by user Chiton magnificus)