An Attempt to Reduce Evaporation of Liquid Media at Low Pressure

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BACKGROUND

- Low pressure hinders microorganism growth on Mars.
- Mars surface pressure reaches as low as 6 mbar, compared to 1 bar on Earth.
- Low pressure causes rapid evaporation of liquid methanogen growth medium.
- In this experiment, we attempted to reduce the rate of evaporation by addition of agar to the liquid medium.
- We also inoculated *Methanobacterium formicicum* in medium with various agar concentrations to verify growth could occur.

METHODS

- 10 mL methanogen growth medium [1] per test tube, with varying agar concentrations (0%, 0.1%, 0.25%, 0.5%), added anaerobically
- Tubes sterilized via autoclave
- Sterile 2.5% sodium sulfide solution added to tubes
- Two tubes at each agar concentration inoculated with 0.5 mL medium containing *M. formicicum*
- All tubes pressurized with H\(_2\) gas
- Inoculated tubes were incubated at 37°F and tested for methane via gas chromatograph
- Tubes (un-inoculated) placed inside Pegasus Planetary Simulation Chamber [2] (Fig. 1)
- Syringe needles inserted into stoppers
- Chamber evacuated to 30 mbar. Filled with 80:20 H\(_2\):CO\(_2\) gas to 500 mbar, and evacuated again to 130 mbar (cycle repeated 3 times).
- Outgassing raised pressure of chamber to 240 mbar.
- Chamber kept at 240 mbar for 18 days

RESULTS

- Figure 1. Pegasus Planetary Simulation Chamber. Left. Insulated chamber with viewports, connections to analysis equipment. Right. Viewport for visual monitoring of experiments.
- Figure 2. Average decrease in height of medium (in mm) between front row and back row of tubes, per agar concentration, after 18 days at 240 mbar within Pegasus Planetary Simulation Chamber. Error bars illustrate one standard deviation.
- Figure 3. Average growth of *M. formicicum* on medium of various agar concentrations (0%, 0.1%, 0.25%, 0.5%). Growth was measured as percent methane produced. Tubes were incubated at 37°F under normal pressure. Error bars indicate one standard deviation.
- Figure 4. Average decrease in height of medium for previous experiment (15 days at 173 mbar) and two agar concentrations from this experiment. Error bars indicate one standard deviation.

DISCUSSION/CONCLUSIONS

- Varying evaporation rates within chamber require further investigation (Fig. 2)
- Agar concentration affects evaporation rate deeper inside chamber (Fig. 2)
- Increased growth of *M. formicicum* supports addition of agar to medium as thickening agent (Fig. 3)
- Evaporation rate varies between experiments (Fig. 4)
- Experiment will be repeated to verify results and analyze evaporation within chamber
- Future work will add Mars soil simulant to agar-medium mixtures as a further deterrent against evaporation

References


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