



Oxygen Tolerance of Methanogens: Possible Metabolic Paths for Life on Mars



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Introduction:

- Methanogens are anaerobic organisms in Archea that produce methane from CO₂ and H₂.
- They also act as primary producers in subterranean environments on Earth.
- Thus, Methanogens may be a model of sub-surface life on Mars.

Objectives:

The primary hindrance of study is the extremely anaerobic nature of Methanogens. The objectives of this study are:

- To determine if Methanogens can withstand short-term exposure to atmospheric O₂,
- To what level their performance is impaired by said exposure, and
- To develop an aerobic technique for rinsing Methanogen cultures of nutrient media.

Methods:

H₂ + CO₂ serves as the best substrate for most Methanogens (3) by the following process:



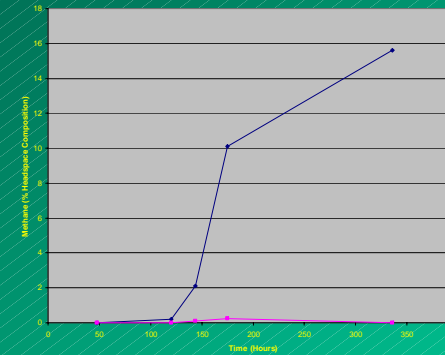
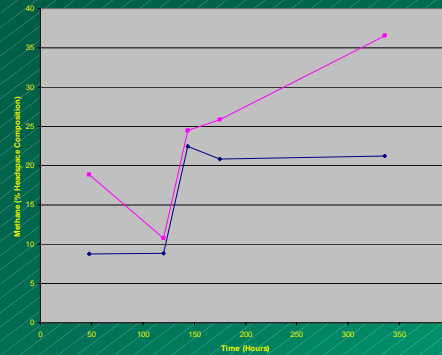
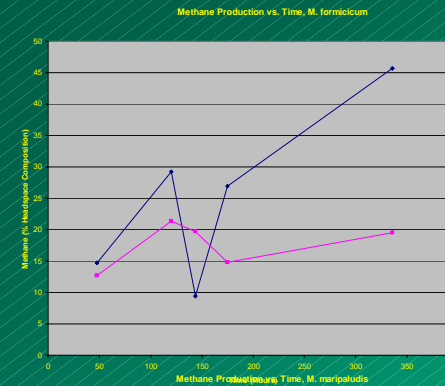
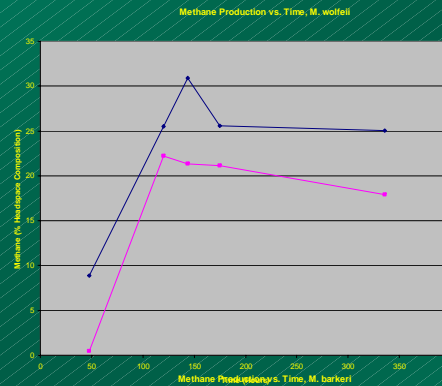
Thus, growth of Methanogens can be tracked by measuring methane production against time. Four organisms were used (see Table 1). Two cultures of each were incubated anaerobically in the standard media and temperature most preferred by each species (see Table 1), at 180 kPa of H₂. The tubes were then allowed to incubate for five days before being rinsed in NaOH/CO₂ buffer. After the procedure, each culture was used to inoculate new tubes of media which were also pressurized with H₂ and allowed to incubate at ideal temperatures. Measurements of methane production were taken.

Table 1

Organism	Media	Temperature (°C)
<i>M. wolfeii</i>	MM	55
<i>M. barkeri</i>	MS	37
<i>M. formicicum</i>	MSF	37
<i>M. maripaludis</i>	MSH	25



Results:



Tables 2-5: Methane production of aerobic and anaerobic rinse groups by species.

Conclusion:

Methanobacterium wolfeii, *Methanosarcina barkeri*, and *Methanobacterium formicicum* all performed well under both techniques. *Methanococcus maripaludis*, an extreme halophile, showed a marked preference for the anaerobic technique despite the large die-off due to lysing in the salt-free buffer suffered by both cultures. Further work is needed and planned, including experiments with a saline-buffer for *M. maripaludis*, but the initial findings of this study are that the *Methanobacterium wolfeii*, *Methanosarcina barkeri* and *Methanobacterium formicicum* are, in fact, very resistant to acute oxygen exposure.