Genome-centric resolution of anaerobic digestion microbiome in biogas reactors fed with Long Chain Fatty Acids

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Anaerobic digestion: State of the art

Many different aspects and problems affecting biogas reactors are directly connected with microbial activity:

- Ammonia rich substrates
- Biogas upgrade
- Foaming
- Temperature disturbances
- Cellulosic and lignocellulosic feedstocks
Experimental design

Case Study 1
- Cattle manure
- Shock Load

Case Study 2
- Cattle manure
- Cattle manure + LCFA
- Change of influent composition
Approach and methodology

1. Biogas Reactors
2. DNA extraction
3. Shotgun Sequencing
4. Bioinformatic Analyses
Results

Kougias et al., 2016. *Scientific reports, 6*, p.28810.
Results
Results

Eu01  Methanoculleus sp. DTU006
Eu04  Methanosarcina sp. DTU009
Results

- Genomes belonging to *Methanoculleus* genus were downloaded from NCBI microbial genome database and were compared using PhyloPhIAn.
Results (novel species)

**Candidatus Methanoculleus thermohydrogenotrophicum**

<table>
<thead>
<tr>
<th>GENOME CHARACTERISTICS</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genome size [bp]</td>
<td>2.15 Mbp</td>
</tr>
<tr>
<td>GC content</td>
<td>59.20%</td>
</tr>
<tr>
<td>Scaffold N50 [bp]</td>
<td>17,178</td>
</tr>
<tr>
<td>Number of contigs</td>
<td>503</td>
</tr>
<tr>
<td>Number of protein-encoding genes</td>
<td>2,297</td>
</tr>
<tr>
<td>Total number of essential genes</td>
<td>32</td>
</tr>
<tr>
<td>Estimated completeness % (CheckM)</td>
<td>92.70%</td>
</tr>
<tr>
<td>Estimated contamination level % (CheckM)</td>
<td>2.30%</td>
</tr>
</tbody>
</table>
Conclusions

LCFA inhibition is a reversible phenomenon
Biogas microbiome unveiled
Syntrophic interactions
Novel species were identified
New opportunities for microbial resource management
Revised this week!

The anaerobic digestion microbiome: a collection of 1600 metagenome-assembled genomes shows high species diversity related to methane production

Dr. Stefano Campanaro, Dr. Laura Treu, Dr. Luis M Rodriguez-R, Dr. Adam Kovalovszki, Dr. Ryan M Ziels, Dr. Irena Maus, Dr. Xinyu Zhu, Dr. Panagiotis G. Kougias, Dr. Arianna Basile, Dr. Gang Luo, Dr. Andreas Schlüter, Dr. Konstantinos T. Konstantinidis, Dr. Irini Angelidaki

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