Continuous nitrification of artificial urine with a bacterial co-culture in a packed-bed bioreactor

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The main goal of the conducted research is to develop a defined microbial consortium to nitrify synthetic urine in the continuous system based on immobilized cells in a packed-bed bioreactor.

Introduction

MELiSSA aims at producing food via vegetable crops and edible phototrophic bacteria. To produce phototrophic biomass conversion of urine into a nitrate substrate should be achieved.

Advantages of biofilm growth in the bioreactor:

- Cell retention in the bioreactor
- Easy continuous operation
- Attached growth more compatible with Space conditions

Results

Continuous culture of *N. europaea*, *N. winogradskyi* and *C. pinatubonensis* (heterotroph) with PVA gel bioreactor beads;

used media – AOB/NOB medium with urea instead of ammonium sulphate

Batch culture of *N. europaea* and *N. winogradskyi* with PVA gel bioreactor beads

Conclusions:

- Nitifying bacteria can form biofilm on PVA gel bioreactor beads
- PVA gel bioreactor beads are good material for nitifying biofilm formation, but cannot be sterilized in 121°C in dry conditions
- Increase of pH during bacterial cultivation can indicate urea hydrolysis, but also CO₂ stripping
- Stabilisation of nitrate concentration can indicate that *N. europaea* and *N. winogradskyi* were active in the culture
- Need to establish new bacterial consortium and new composition of synthetic urine medium to improve urea to nitrate transformation efficiency

Future tests

Taking as a basis these preliminary results, a more systematic work was planned in order with the final target to test it in the MELiSSA Pilot Plant:

a) Selection of the optimal defined microbial consortium
b) Definition of synthetic urine medium composition
c) Selection of an autoclavable, non-compressible biofilm carrier supporting good biofilm development
d) Preliminary tests in the bench scale packed-bed bioreactors