Jožef Stefan Institute
Center for Technology Transfer and Innovation

TECHNOLOGY OFFER

CONTROLLED AGGREGATION OF MICROBIAL CELLS

Fields of use
Microbiology, Micro- and Nanotechnology related to Biological sciences, Fermentation, Bioprocesses, Biocontrol, Enzymology, Protein Engineering, Fermentation, Microbiology, Micro- and Nanotechnology related to Biological sciences, Food & feed ingredients, Plant health

Current state of technology
Under development/lab tested

Type of cooperation
Technical cooperation agreement

Intellectual property
Patent(s) applied for but not yet granted

Developed by
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More information about the invention

Summary

A Slovenian research organization has developed a method for controlled aggregation of microbial cells. The method is useful in different biotechnology fields such as plant and food biotechnology, fermentation, remediation, biofouling etc. Partners, who use microbial co-cultures in their biotechnological applications, are sought for technical cooperation agreements to validate the technology in industrial environment.

Description of the invention

Use of microbial co-cultures is getting more and more important in many biotechnological processes, such as food biotechnology, plant biotechnology, production of fuels, fermentation, remediation, biofouling etc. It can improve the process or the final biotechnological product.

The systems of co-culture are hard to optimize due to different growth dynamics of different strains and increased distances between cells when complex substrates are broken down to the level that is acceptable for use by microbes that produce desired substances. For example, scavenging oxygen is currently difficult to monitor within the whole microbial culture. Also, the co-culture process is often separated into two steps, aerobic and anaerobic, and managing the process with currently available techniques is limited in efficiencies due to the large distances between the cells.

A Slovenian research organization has developed a method for controlled aggregation of microbial cells, which enables close contact between cells and more intensive interactions. Moreover, the precise placement of different bacterial cells using a top-down approach enables preparation of smart carriers composed of particular cells placed in particular spaces. The interactions facilitate (i) exchange of growth substrates, secondary metabolites as well as quorum sensing molecules, (ii) increased local scavenging of oxygen, enabling the formation of anaerobic niches within the aggregates, and (iii) determination of temporal and spatial activities of multicellular aggregated formations.

The novel method enables layering of microbial cells of the same or different type in a way that controls the size, structure and number of aggregates as well as the potential spatial distribution of the different species of cells within the aggregates. Microbial cells are coated with charged polyelectrolytes as well as magnetic nanoparticles or any other types of organic or inorganic colloids, which enables building layers of microbial cells in either two- or three-dimensional structures. Laboratory experiments have been successfully conducted on Escherichia coli, Pseudomonas putida, and Pseudomonas stutzeri as well as on Lactococcus lactis and different Staphylococcus spp. and Bacillus spp. strains, and the cells were separated from the solution.

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Main Advantages

The cellular aggregates formed by this method have the following advantages compared to existing/known co-culture technology:

- Microbes can transfer metabolites more efficiently, produce biofilms and develop particular niches based on local physico-chemical properties.
- Cell aggregation process can be controlled to achieve the desired size and distribution of cells.
- Controlled aggregation can improve properties of final product (plant biomass; taste and structure of different food...) and biotechnological process (i.e. remediation).

Partner Sought

The Slovenian research organization would like to validate this technology in a relevant industrial environment and is looking for partners for a technical cooperation agreement. The technology has many applications in different biotechnology fields such as plant and food biotechnology, remediation, biofouling as well as in medical setups including preparation of vaccines and bacteriotherapy in anticancer treatments etc. The role of partner(s) would be to test the developed method on their applications (usage of microbial co-cultures for different biotechnological processes) in technical cooperation agreement.