Environment

Biosurfactants production in biofilm reactor and their recovery by pertraction

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This study was focused on production and isolation of microbial surfactants with interesting properties for application in agriculture, petrol industry, pollution remediation and pharmaceutical fields. The biosurfactant production was performed by free and immobilized aerobic cells of *Bacillus subtilis* ATCC 21332. This strain produces lipopeptides of the surfactin and fengycin families. The colonizing behavior of *Bacillus subtilis* strain was evaluated under several experimental and cultural conditions at different sterile solid materials with modified surface properties. After preliminary screening tests with five polymer materials, polypropylene foamed with powder activated carbon (PPch) was selected for cells immobilization and production of lipopeptides. The aims of work are to develop a new technology using the specificity of a biofilm reactor as well as a perspective continuous separation based on a liquid membrane technique (known also as pertraction). Using the classical aerated reactor the lipopeptides generate extensive foaming that imposes difficulties on plant-scale process realization. In order to avoid this drawback, while using the new type reactor conditions, the air was injected over the surface of cultural medium. With this configuration, the biofilm on the solid support and the culture medium are alimented in oxygen directly from the interfaces. The obtained results showed that the production of both lipopeptides and especially of the fengycin was greatly enhanced by the immobilization. The longer time of preliminary cells colonization enhanced highly the production of surfactin, especially at the beginning of fermentation process (the first 24 h). This effect was less evident after 48 h fermentation. To confirm the applicability of the liquid membrane process to lipopeptides recovery from aqueous media, including fermentation broth, extraction behavior of the lipopeptides into organic solvents was studied. For both lipopeptides the degree of extraction into the alkanes n-heptane and dodecane was found to vary with the aqueous solution acidity: it was relatively high at slightly acid (pH = 5.5-6.0) or slightly basic conditions (pH = 8.0-9.0), whereas the extraction was very limited at neutral zone of pH. The degree of surfactin extraction was found to be higher than the fengycin one at the same conditions and the n-heptane was a more efficient solvent for both lipopeptides. Kinetics of surfactin recovery from fermentation broth applying batch pertraction in a rotating discs contactor was studied. Lipopeptide was successfully extracted using n-heptane as liquid membrane and a 0.2 mol·l⁻¹ phosphate buffer solution (pH ~ 7.3) as a receiving phase. However, the stripping of the organic liquid and surfactin accumulation into the receiving phase were less efficient.

Keywords. Biosurfactants, surfactin, biofilm reactor, liquid membranes, pertraction.

Determination of phospholipids extracted from *Tsukamurella paurometabola* C-924 after freeze-drying and during the subsequent storage

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The total lipids of *Tsukamurella paurometabola* C-924 were analyzed after freeze-drying. Seven individual lipids classes were identified namely neutral lipids (NLs), fatty acids (FAs), phospholipids (PLs), sterol ester (SEs), triglycerides (TGs), diglycerides (DGs) and monoglycerides (MGs). The principal fatty acids identified in most lipid classes were palmitic ($C_{16:0}$), palmitoleic ($C_{16:1}$), oleic ($C_{18:1}$), linoleic ($C_{18:2}$), and linolenic ($C_{18:3}$). PLs were the major constituents and accounted for 50-60% of the total lipids. PLs were fractionated. PLs of *Tsukamurella paurometabola* content phosphatidic acid (PA), phosphatidylethanolamine (PE), phosphatidylinositol (PI), phosphatidylcholine (PC), sphingomyelin (SM), lysophosphatidylcholine (LPC) and phosphatidylglycerol (PG). It was observed that PG had the highest proportion at most points relative to other PLs and was the predominant component of PLs (30%-56%). Evolution of individual rate was followed during storage at 20°C and 40°C with or without lithothamne400®, respectively.

Keywords. Lactic acid bacteria, fatty acids, phospholipids class separation, light-scattering detection, survival, temperature.

Performance monitoring and optimization of industrial processes

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Data mining refers to extracting useful knowledge from large amounts of data. It is a result of the natural evolution of information technology and development of recent algorithms. Starting from large databases, the main objective is to find interesting latent patterns. In the end, the quality of a model is assessed by its performance for predicting new observations. Bagging and boosting are general strategies for improving classifier and predictor accuracy. They are examples of ensemble methods, or methods that use a combination of models. The bagging algorithm creates an ensemble of models (by boostrap sampling) for a learning scheme where each model gives an equally-weighted prediction. Particularly, random forests are a combination of tree predictors such that each tree depends on the values of a random vector sampled independently and with the same distribution for all trees in the forest. Internal estimates are also used to measure variable importance. Within the framework of a Kraft pulp mill, we analyze recovery boilers pollutants and steam production. This kind of boiler acts both as a high-pressure steam boiler and as a chemical reactor with reductive and oxidative zones. The steam is used in other mill processes and to run a steam turbine in order to produce electrical energy. Significant perspectives are already existing to optimize this production and reduce atmospheric pollutants. Nowadays random forests modeling is a promising way to achieve that.

Keywords. Data mining, random forests, Kraft pulping process, recovery boiler.