The aim of the research is the purification of biomolecules for therapeutic use, biomedical and biotechnology applications using affinity convective chromatography. In this area two classes of separations are considered: purification of biomolecules and selective apheresis. The research activity is both experimental and theoretical, with a particular emphasis on mathematical modelling.

The experimental activity is focused on the functionalization and characterization of membranes and other chromatographic supports for purification of extracellular vesicles, monoclonal antibodies, proteins and different biomolecules. The choice of appropriate materials, membranes, ligands and spacer arms, is the first step towards the development of affinity membranes. Ligand immobilization is the critical step of the process, since the ligand needs to maintain its functionality while immobilized on the support. The choice of the spacer arm, that acts as a linker between membrane and ligand is crucial for the process. Affinity membranes are initially characterized in batch using pure protein solutions, then the protein of interest is purified from the complex solution (e.g. surfactant of cell culture or serum) where it originates. The experimental characterization is mainly performed using a low pressure chromatographic system, FPLC, in which columns with the solid supports to be characterized (beads, membranes or monoliths) are operated. The relevant transport parameters and the kinetic parameters of adsorption and elution are determined from the experimental data, it is important to note that kinetic parameters need to be determined for every protein/ligand system. A mathematical model has been developed for the description of the whole chromatographic cycle: adsorption, washing and elution. Model validation has been performed with experimental data obtained with a bench scale apparatus for different affinity systems, using both membranes and monoliths, with different proteins and ligands. Scale-up studies using the model as a predictive tool for bioprocess design are also performed.
MAIN PUBLICATIONS


RESEARCH PROJECTS

EU FP6 NMP3-CT-2004-500160, Project: AImS “Advanced Interactive Materials by Design”.

IT PRIN 2008, Project: “Sviluppo di membrane di affinità per anticorpi monoclonali”.

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