Effect of physicochemical characteristics of filtration membranes on peptide migration and selectivity during electrodialysis with filtration membrane

Electrodialysis with filtration membrane (EDFM) is a promising technology for bioactive peptide separation. However, the filtration membrane (FM) material and their physicochemical properties may have an impact on the overall EDFM performance. Therefore, this study aimed to understand the effect of these membrane materials and their physicochemical characteristics on the migration and selectivity of a well-characterized whey protein hydrolysate during EDFM. In this study, EDFM was carried out with six different FM: two conventional FM (PES (as control) and PVDF) and four novel FM (two PCV-silica (CF55 and S11) and two PVC-silica carrying charged functional groups (S11+ and S11-)). Prior to EDFM, the physicochemical properties (thickness, conductivity, contact angle, zeta potential, roughness, and porosity) of these membranes were characterized. Peptides migrated to the anionic (A^-_{RC}) and/or cationic (C^+_{RC}) peptides recovery compartments during EDFM were quantified and identified. PVDF and CF55 gave inconsistent peptides migration rates, without any selectivity of peptides while rest of the membranes behaved as expected but at a different level according to their physicochemical characteristics. Thus, after 120 minutes of EDFM, no peptide was detected in A^-_{RC} and C^+_{RC} with S11- and S11+ respectively, whereas the peptides concentration in C^+_{RC} (108.9±19.4 $\mu g/ml$) with S11- and A^-_{RC} (195.6±4.4 $\mu g/ml$) with S11+ were higher than with the control membrane (C^+_{RC}=39.53±3.39 $\mu g/ml$, A^-_{RC}= 25.4±0.55 $\mu g/ml$). Amongst migrated peptides, VYVEELKPTPEGDLEILLQK (pI=4.25, slightly hydrophilic) was recovered in the highest abundance in the A^-_{RC} with S11+ whereas IPAVFK (pI=8.75, hydrophobic) in the C^+_{RC} with PES. The obtained results indicate that the migration and selectivity of peptides are mainly related to the zeta potential, porosity, and the presence of hydrophilic pores. These results are the part of a first statistical model to select the appropriate membranes for the separation of a peptide of an interest according to their reciprocal physicochemical properties.

Keywords: Electrodialysis with filtration membrane, membrane materials, peptide migration, peptide selectivity