ISGC 2022

N°1095 / PC
TOPIC(s) : Chemical engineering

Purification of coenzyme A disulfide by an environmentally friendly method: membrane filtration

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PURPOSE OF THE ABSTRACT

Introduction

Biocatalysis is an alternative to chemical processes and fermentation, for the production of molecules with high added value. It makes it possible to catalyze reactions using enzymes, which is either autonomous or dependent on a coenzyme. The high cost of many coenzymes limits the development of certain enzymatic processes. This is notably the case for coenzyme A which is required for 4% of known cellular enzymes 1 and whose price is $2160/g 2, for a purity greater than 85%. This coenzyme also exists in the form of a more stable dimer: coenzyme A disulphide. This dimer, sold for $31,600/g 3, can be transformed into coenzyme A by simple disulphide bond reduction. The high costs of these molecules of interest are explained, among other things, by the purification method used.
The present study focuses on the purification of coenzyme A disulfide (CoAS)2, by a responsible technique; membrane filtration; after formation of (CoAS)2, in our laboratory 4. The (CoAS)2 is purified, by tangential dia-ultrafiltration, from adenosine triphosphate (ATP), adenosine diphosphate (ADP) and adenosine monophosphate (AMP), present in solution.

Screening of membranes / Optimization of starting concentration / Purification by diafiltration of coenzyme A disulfide

Seven flat sheet polymeric ultrafiltration and nanofiltration membranes were chosen for the purification of (CoAS)2, with reference to their molecular weight cut-off (MWCO) and pH range. These membranes were tested in tangential mode at laboratory scale. Their selectivity (rejection rate) as well as their productivity (flux) were evaluated. As a result, a membrane with the best selectivity/productivity compromise was selected as well as the working pressure.
Then, the concentration of the starting solution was optimized in order to increase the dry matter in solution, in order to limit the water consumption, while having an acceptable concentration polarization. Three new total concentrations were tested. One of them, presenting the best compromise of permeate flux and predicted purity/ losses, was chosen.
After selection of the membrane, pressure and concentration, the diafiltration of the solution of (CoAS)2 was carried out in tangential mode. This process was able to purify (CoAS)2 up to 68%, while having acceptable losses of (CoAS)2 (20%). By overcoming technical constraints, the purity could be brought to commercial purity, in just a few volumes of diafiltration.

Comparison of current (CoAS)2 purification techniques to membrane diafiltration

The most economical existing technique to produce 85% (CoAS)2 uses two anion exchange columns, LiCl, activated carbon, water and acetone containing ammonia 5. The process, set up here, makes it possible to purify (CoAS)2 without any organic solvent. This is a responsible technique that is easy to scale up.

FIGURES

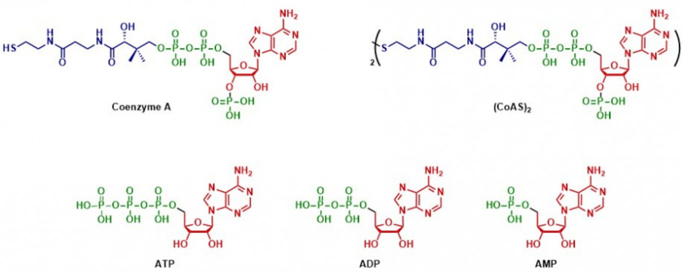

FIGURE 1

Figure 1: Structure of coenzyme A, (CoAS)2, ATP, ADP and AMP

(CoAS)2 coenzyme A disulfide , ATP adenosine triphosphate, ADP adenosine diphosphate, AMP adenosine monophosphate

FIGURE 2

KEYWORDS

purification | membrane | coenzyme

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