World Academy of Science, Engineering and Technology
International Journal of Bioengineering and Life Sciences
Vol:10, No:08, 2016

Vitamin B9 Separation by Synergic Pertraction

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Abstract : Vitamin B9 is an important member of vitamins B group, being a growth factor, important for making genetic material as DNA and RNA, red blood cells, for building muscle tissues, especially during periods of infancy, adolescence and pregnancy. Its production by biosynthesis is based on the high metabolic potential of mutant Bacillus subtilis, due to a superior biodisponibility compared to that obtained by chemical pathways. Pertraction, defined as the extraction and transport through liquid membranes consists in the transfer of a solute between two aqueous phases of different pH-values, phases that are separated by a solvent layer of various sizes. The pertraction efficiency and selectivity could be significantly enhanced by adding a carrier in the liquid membrane, such as organophosphoric compounds, long chain amines or crown-ethers etc., the separation process being called facilitated pertraction. The aim of the work is to determine the impact of the presence of two extractants/carriers in the bulk liquid membrane, i.e. di(2-ethylhexyl) phosphoric acid (D2EHPA) and lauryltrialkylmetilamine (Amberlite LA2) on the transport kinetics of vitamin B9. The experiments have been carried out using two pertraction equipments for a free liquid membrane or bulk liquid membrane. One pertraction cell consists on a U-shaped glass pipe (used for the dichloromethane membrane) and the second one is an H-shaped glass pipe (used for h-heptane), having 45 mm inner diameter of the total volume of 450 mL, the volume of each compartment being of 150 mL. The aqueous solutions are independently mixed by means of double blade stirrers with 6 mm diameter and 3 mm height, having the rotation speed of 500 rpm. In order to reach high diffusional rates through the solvent layer, the organic phase has been mixed with a similar stirrer, at a similar rotation speed (500 rpm). The area of mass transfer surface, both for extraction and for reextraction, was of $1.59x10^{-3}$ m2. The study on facilitated pertraction with the mixture of two carriers, namely D2EHPA and Amberlite LA-2, dissolved in two solvents with different polarities: n-heptane and dichloromethane, indicated the possibility to obtain the synergic effect. The synergism has been analyzed by considering the vitamin initial and final mass flows, as well as the permeability factors through liquid membrane. The synergic effect has been observed at low D2EHPA concentrations and high Amberlite LA-2 concentrations, being more important for the low-polar solvent (n-heptane). The results suggest that the mechanism of synergic pertraction consists on the reaction between the organophosphoric carrier and vitamin B9 at the interface between the feed and membrane phases, while the aminic carrier enhances the hydrophobicity of this compound by solvation. However, the formation of this complex reduced the reextraction rate and, consequently, affects the synergism related to the final mass flows and permeability factor. For describing the influences of carriers concentrations on the synergistic coefficients, some equations have been proposed by taking into account the vitamin mass flows or permeability factors, with an average deviations between 4.85% and 10.73%.

Keywords : pertraction, synergism, vitamin B9, Amberlite LA-2, di(2-ethylhexyl) phosphoric acid
Conference Title : ICBT 2016 : International Conference on Bioengineering and Technology
Conference Location : Venice, Italy
Conference Dates : August 08-09, 2016