Cellular Transplantation and Tissue Engineering 2012 vol.7 N3, pages 41-48

Direct observation of «cholesterol - Model of biological membrane» complex by NMR spectroscopy

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Abstract

Interaction and aggregation of cholesterol and sodium dodecyl sulfate molecules were studied in this paper. Sodium dodecyl sulfate was taken as a model for biological membranes. Cholesterol-sodium dodecyl sulfate complex was described by modern methods of nuclear magnetic resonance spectroscopy. Nuclear magnetic resonance spectra were recorded on «Avance-500» spectrometer (Bruker). To assign 1H signals of cholesterol, sodium dodecyl sulfate and cholesterol+sodium dodecyl sulfate mixture in nuclear magnetic resonance spectra literature data was used, and 2D homo- end hetero-correlation nuclear magnetic resonance spectra were recorded. To study the formation of sodium dodecyl sulfate micelles and complex of cholesterol-sodium dodecyl sulfate micelles selective nuclear Overhauser effect spectroscopy experiments were carried out. The formation of sodium dodecyl sulfate micelles in dimethyl sulfoxide solution was confirmed by nuclear Overhauser effect spectroscopy data. The presence of a complex between sodium dodecyl sulfate micelles and cholesterol molecules has been proven by selective nuclear Overhauser effect spectroscopy experiments. Nuclear Overhauser effect between OH-group of cholesterol and «tail» groups of sodium dodecyl sulfate hydrophobic part was observed in the experiment. This observation corresponds to close spatial arrangement of these parts of different molecules and the presence of a complex between cholesterol and sodium dodecyl sulfate micelles. On the basis of the nuclear magnetic resonance experiments was established that molecules of sodium dodecyl sulfate form micelles in dimethyl sulfoxide solution at concentrations above the critical micelle concentration. Cholesterol molecules form an intermolecular complex with sodium dodecyl sulfate micelles by interaction of the OH group of cholesterol and CH3-1 and CH2-2 «tail» aliphatic groups of sodium dodecyl sulfate. This interaction is similar to the behavior of cholesterol in phospholipid bilayer membranes in which cholesterol enters its cyclic part in the hydrophobic tails of phospholipid molecules oriented primarily across the bilayers.

Keywords

Cholesterol, Micelles, Nuclear magnetic resonance spectroscopy, Nuclear Overhauser effect, Sodium dodecyl sulfate