# Phase structure and molecular mobility of drug delivery systems based on liposomes with Pluronics by nuclear magnetic resonance method

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## Introduction

The application of traditional liposomes as drug delivery systems (DDSs) faces difficulties due to their instability and very short life time. To solve this problem liposome are supplemented with various polymers/copolymers, which help prevent the degradation of lipid DDSs in biological media and prolong the circulation time of the drug in the body [1, 2]. For example, Pluronics consisting of blocks of polypropylene oxide (PPO) and polyethylene oxide (PEO) can be used as copolymers [3].

In this work, the effect of Pluronic F127 on the phase behaviour of systems based on phosphatidylcholine liposomes was studied by $^{31}$P NMR spectroscopy, the molecular mobility of the system components was analyzed by $^{1}$H NMR relaxometry and translational diffusion by $^{1}$H NMR diffusometry.

## Results and discussions

Comparative analysis of $^{31}$P NMR spectra of multilamellar lipid liposomes without Pluronic and with Pluronic showed that in the first case there is only lamellar liquid crystalline (LC) phase in the system, and when Pluronic is added, an isotropic peak appears in the whole temperature range studied (Fig. 1). The presence of an isotropic phase can be explained by the formation of micelles containing lipids.

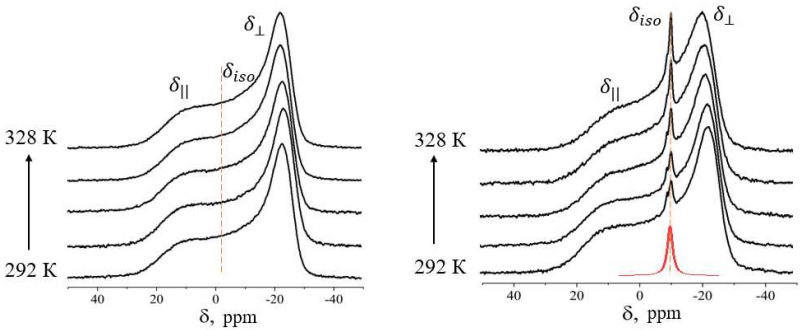


*Figure 1. $^{31}$P NMR spectra for a suspension of phosphatidylcholine (left) and phosphatidylcholine with Pluronic F127 concentration of 2.5 mol% (right) at varying temperatures*

According to $^{1}$H NMR relaxometry data, the decay of transverse magnetization for the phospholipid system with Pluronic are due to the sum of contributions from the "liquid-phase" components and the "solid component" with a characteristic transverse relaxation time $T_{2s}$ ~20 ms. Thus, the system of phosphatidylcholine with Pluronic combines the properties of both liquid and solid.

According to NMR diffusometry data, diffusion decay can be divided into two components with quite different self-diffusion coefficients. One of the components $D_1$ grows

from $1 \cdot 10^{-12}$ to $5 \cdot 10^{-12}$ $m^2/c$ with increasing temperature. The other component is independent of temperature and is characterized by an average value of $D_2 \sim 2 \cdot 10^{-15}$ $m^2/c$.

## References


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