Determination of the enclosed volume of DODAC vesicular dispersions by means of NMR diffusometry and T$_2$ relaxometry.

Paolo Sabatino$^a$$^b$, Pieter Saveyn$^a$, José C. Martins$^b$, Paul Van der Meeren$^a$

$^a$Particle and Interfacial Technology Group, Faculty of Bioscience Engineering, Ghent University, Belgium
$^b$NMR and Structure Analysis Unit, Department of Organic Chemistry, Ghent University Belgium
Paolo.Sabatino@UGent.be

The enclosed volume is an important characteristic of vesicular dispersions. First of all, it determines the encapsulation potential of water-soluble compounds. In addition, the enclosed volume largely determines the dispersed phase volume fraction and, hence, affects the rheology of concentrated vesicular dispersions, as used, for example, in fabric softeners or cosmetics.

Low resolution NMR techniques, such as pfg-diffusometry and T$_2$ relaxometry have been proven to be useful to determine the enclosed volume of multilamellar dioctadecyldimethylammonium chloride (DODAC) vesicular dispersions.

The estimation of the enclosed volume with pfg–NMR diffusometry method is based on the different diffusion behaviors of water in the external and internal phases. The main advantage of this method is that an external tracer is not necessary. T$_2$ relaxometry, on the other hand, does require the addition of an external paramagnetic probe (MnCl$_2$) to differentiate the relaxation behaviors of water in the two phases.

We show that, when water exchange between the bilayer inner core and the external solution (and vice versa) does not occur, i.e., at low temperature, both the two methods are reliable and resulted in similar values that reflect the real enclosed volume. At higher temperature, however, some discrepancy is noticed, due to the enhanced bilayer permeability of the DODAC vesicles, leading to an underestimation of the enclosed volume. In addition, the T$_2$ relaxometry method has been used to quantify the membrane permeability toward the paramagnetic tracer during long storage and the osmotic shrinkage caused by addition of hyperosmotic paramagnetic solution.

[1] Enclosed volume determination of concentrated DODAC vesicular dispersions by low resolution proton NMR diffusometry and T$_2$–relaxometry