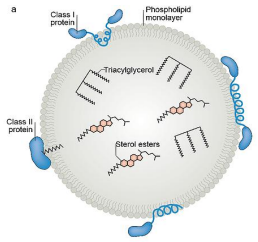
The deposition of a monolayer of phospholipids at the oil/water interface.

INTRODUCTION

In many areas, monolayers are at the crossroad of interfaces between immiscible phases forming emulsions. There are different types of monolayers which can be surfactants molecules, like lipids, polymers, proteins, asphaltenes, solid particles… Generally one of the 2 immiscible phases is water and the other can be natural oil, alkane of variable chains or volatile solvent like chloroform, toluene…
Lipid droplets [1] are organelles consisted of a core of neutral lipids (triglycerides, sterol esters, liposoluble vitamins) and a monolayer of phospholipids in which proteins are embedded (involved in regulation, structure, synthesis and lipid mobilization).



[1] Lipid droplet Schematic representation.

METHODOLOGY

One of the most reliable methods to study the behavior of a monolayer of phospholipids at the oil/water interface is to use the automated drop tensiometer Tracker™. The measurement of the surface tension as a function of time indicates how long it takes for the surfactant to come at the interface and how effective is the surfactant to lower the surface tension (lower is the tension, more the energy to disperse the two phases will be low).

EXPERIMENTAL PROTOCOL

An oil drop immerged in a buffer with an injection of large unilamellar vesicules is performed to monitor the adsorption of phospholipids at the oil/water interface.

The adsorption of two types of phospholipids is monitored at the surface of an oil drop (pure triolein):

- egg PC (lecithin from egg yolk)
- POPC (1-palmitoyl-2-oleoyl PC)

RESULTS

For both sources of phospholipids egg PC and POPC, LUVs were adsorbed to the surface of the oil drop. Fig. 2 and 3 show the values of the area and surface tension during experiment. Three distinct phases during the adsorption of phospholipids were observed:

1. a lag phase with a very little change in surface tension
2. a rapid reduction in surface tension
3. a gradual lowering up to the equilibrium surface tension.

The surface tension measured at the beginning of the experiment was 30 mN/m and rapidly lowered to 18.6 ± 1.2 mN/m for egg PC and 15.4 ± 0.3 mN/m for POPC.

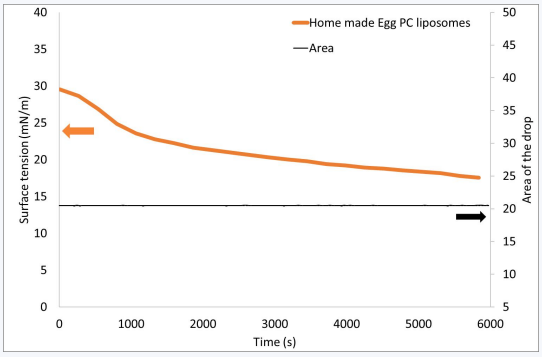


Fig. 2: Variation of surface tension at the triolein/water interface as the function of time (drop of 10 µL) in presence of 0.005% of egg PC « home made » LUVs.

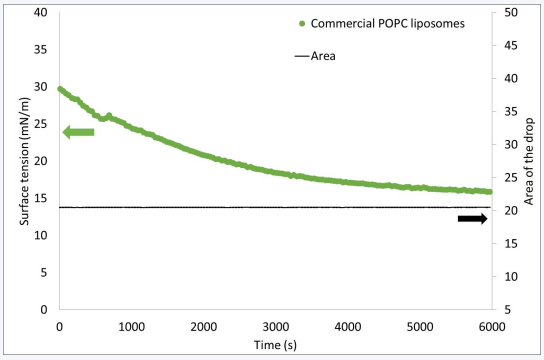


Fig. 3: Variation of surface tension at the triolein/water interface as the function of time (drop of 10 µL) in presence of 0.005% of commercial POPC LUVs.

CONCLUSION

Using Tracker™ allowed to probe the deposit of phospholipids at the surface of an oil drop.
Injecting LUVs into the aqueous phase, they behave as vehicles allowing the transfer of phospholipids at the interface. They can be used as systems to study the interfacial behavior of various molecules at triolein/phospholipid/water interface, closely related to a true biological interface of cellular lipid droplets found in the physiology.

References

[1] Olzmann, J.A. and P. Carvalho, Nat Rev Mol Cell Biol, 2019. **20**(3): p. 137-155.