Preliminary study to evaluate atmospheric pressure plasma jet applicability to disrupt liposomal membranes

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Liposomes (LIPs) consist of phospholipid bilayers and are currently being used as carriers for drug delivery and targeting [1]. Hydrophilic active substances may be loaded in LIPs and for characterization of such formulations a standard method is to disrupt LIP membranes with detergent (as Triton X-100) and measure released active concentration. However, the presence of the detergent may interfere with the analytical procedure used. We have performed a preliminary study in order to understand if plasma jet could be useful for LIP disruption. A jet device similar to the one presented in [2] has been used. The system is fed with high purity helium at atmospheric pressure and driven by sinusoidal high voltage (10 kHz, 11 kV peak-to-peak). As hydrophilic substance we used a highly fluorescent compound, calcein, at a concentration of 100 mM at which its fluorescence intensity (FI) is quenched, permitting easy determination of its leakage from vesicles (since FI is de-quenched due to dilution, when the encapsulated molecules are released in the aqueous dispersion media) [3]. MultiLamellar Vesicle (MLV) and Small Unilamelar (SUV) liposomes, encapsulating calcein (100mM) and consisting of egg lecithin (PC) or saturated lipid DSPC (which forms more rigid bilayers) were prepared by thin film hydration and probe sonication (for SUV) [1]. Vesicle hydrodynamic mean diameter and size distribution were determined by dynamic light scattering (Malvern, Nanosizer). The liposomes were subjected to cold plasma at different lipid concentrations and for different time periods (as seen in Table 1).

Table 1 . Effect of plasma jet treatment on calcein retention in Liposomes

Lipid comp.	Lipid conc. (mg/ml)	Calcein Latency (%)			
Plasma (min)		0	1	2	5
PC(SUV)	1	94.5	94.6	93.7	94.1
	2	93.3	92.9	92.6	92.5
	7	90.5	89.8	89.2	88.5
	12	93.3	-	90.7	83.9
PC(MLV)	1	81.4	-	71.5	22.9
DSPC	10	98.9	-	93.8	91.8

Preliminary results reveal that LIP membranes become more sensitive to atmospheric pressure plasma jet treatment when: (i) their size increases (MLV/SUV); (ii) lipid membrane is less rigid (PC/DSPC); and (iii) at higher lipid concentrations.

References

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