Interactions of Inorganic Mercury with Phospholipid Monolayers

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Figure 1. Profiles of the electron density for sphingomyelin monolayers obtained from the best fit of the X-Ray reflectivity curves on 10^{-4} M HgCl_2 solution. Dashed lines illustrate the division of the molecule into boxes of homogenous electron density.

The interactions of mercury ions with the membrane phospholipids are considered to be of great importance as regards the toxicity of this metal in living organisms [1-3]. To get a deeper insight into this problem, we have performed systematic studies applying the Langmuir technique complemented with synchrotron X-Ray scattering methods (Grazing Incidence X-Ray Diffraction (GIXD) and X-Ray Reflectivity (XR)). We focused our attention on the interactions of inorganic mercury salts dissolved in the aqueous subphase with lipid monolayers, formed by selected membrane phospholipids, namely dipalmitoylphosphatidylglycerol (DPPG), dipalmitoylphosphatidylcholine (DPPC), 1-octadecyl 2-sn-phosphatidylcholine (lyso-PC) and sphingomyelin (SM). Two different inorganic mercury salt: one of a hydracid, HgCl_2, and the other of an oxacid, Hg(NO_3)_2, have been investigated.

Our results proved that elastic properties of phospholipid monolayers are a key factor as regards the interactions with mercury ions. Significant differences in mercury ions complexation are observed with double-chain phospholipids (such as DPPG and DPPC), forming fluid layers of low compressibility, and phospholipids forming more compressible films (like SM and lyso-PC). Namely, important changes in the monolayer characteristic were observed only for the latter kind of lipids. This is important finding taking into account the accumulation of mercury in central nervous system and its neurotoxic effects. SM is one of the most abundant lipids in neurons shells and therefore can be considered as a target lipid complexing mercury ions.