

Chiral Discrimination in N-(O, O-dialkyl)phosphoamino Acid Monolayers at the Air-water Interface

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Abstract: In this paper, chiral discrimination in N-(O,O-dialkyl)phosphoamino acid monolayers at the air/water interface was studied and it was revealed that the D:L=1:1 racemic monolayer of N-(O, O-dihexadecyl)phosphoalanine is packed more densely in solid phase while shows a higher LE to LC transition pressure than the enantiomeric ones.

Keywords: Chiral discrimination, N-(O,O-dialkyl)phosphoamino acid, monolayer.

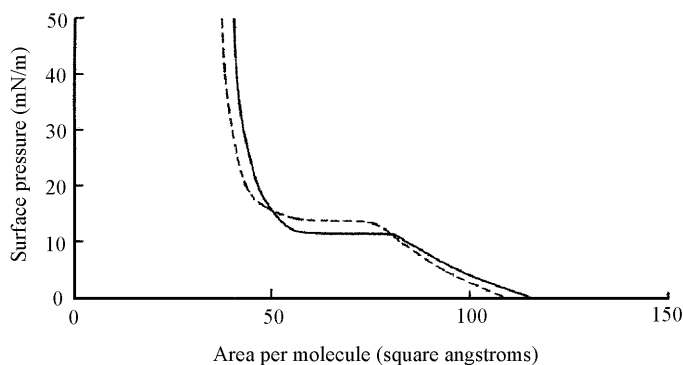
The chirality of phospholipids is known to be of importance to the interactions of the cell membrane with proteins and other substances passing through it. Langmuir monolayers at the air/water interface provide unique models for studying chirality-dependent intermolecular interactions in highly organized two-dimensional systems¹⁻². Our recent work confirmed that long chain N-(O,O-dialkyl)phosphoamino acids could form bilayer membrane vesicles in water⁴. This suggests that perhaps these molecules could be very important in the study of bio-membrane, especially in the prebiotic times.

In this paper, we present the result of the study on chiral discrimination behavior of N-phosphoamino acids by comparing the surface pressure *versus* area per molecule isotherms of the enantiomeric and racemic monolayers. This study may open a new way of understanding the contributions made by these molecules to the forming of LB membrane.

Surface pressure *versus* area per molecule isotherms of the enantiomeric DNHP-L-Ala (N-(O,O-dihexadecyl)phosphoryl L-alanine), DNHP-D-Ala (N-(O,O-dihexadecyl) phosphoryl D-alanine) and the D:L=1:1 racemic DNHP-D/L-Ala are compared and shown in **Figure 1**. The isotherms of two enantiomeric monolayers are identical within experimental error limit, but it is obvious that the racemic monolayer is packed more densely in S-phase, which suggests a heterochiral behavior. However, the liquid expanded to liquid condensed transition pressure for the racemic monolayer is higher than that for the enantiomeric monolayer, which is rather unusual for the heterochiral behavior. Andelman³ has introduced the identification of chiral behavior of a monolayer by drawing analogy with sublimation of bulk chiral system. He argued that when only the pure D or L and the D:L=1:1 isotherms are available, a heterochiral

behavior can be identified for the case where the D:L=1:1 transition pressure is lower than the enantiomeric pure one, however, the chiral behavior cannot be identified unambiguously for the opposite case where the transition pressure for the D:L=1:1 isotherm is higher than for the enantiomeric pure one. So further study on this special chiral discrimination behavior would be of much interest.

Figure 1. Comparison of surface pressure *versus* area per molecule isotherms of the enantiomeric DNHP-L-Ala, DNHP-D-Ala (both by solid line) and the D:L=1:1 racemic DNHP-D/L-Ala (dashed line) at 21°C. Compression rate 0.8 cm²/s. Subphase pH5.3



Monolayers consisting of molecules, such as N-acyl amino acid amphiphiles have been studied with much emphasis for gaining more insight into the order of chiral monolayers, for these model substances fulfill several important requirements for simulating membranes and interfacial processes at membrane surfaces¹. N-(O, O-dialkyl)phosphoamino acids are similar in structure with the above molecules, so it is expected that this new type of model molecule would be of great value in the study of simulating membrane structures and functions.

References and Notes

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