Simple Lecithin-Protein Model

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Latex particles may be coated by various lecithins and protein to study their electrophoretic mobilities using the technique of cell electrophoresis. It was demonstrated that the degree of purity of L-α-lecithin profoundly affected the particle mobility; exposure of lecithin-coated latex to gamma globulin also resulted in significant differences in mobility related to the purity of the lecithin.

STUDIES OF protein monolayers at the oil/water interface are considerably less numerous than those at the air/water interface because of the technical difficulties encountered, although the sensitive technique of cell electrophoresis has been somewhat neglected in this regard (1). Recently, we have utilized a simple model that appears to provide a reproducible technique for studying the electrophoretic mobilities of lecithin-protein complexes. Briefly, the method depends upon coating polystyrene latex particles[1] (6–14 μ diameter) with lecithin, followed by protein, and measuring the particle mobility with cell electrophoresis.

The cell electrophoretic procedure has been described in detail previously (2); the electrophoretic solution consists of a phosphate-sucrose buffer (pH 7.0, ionic strength 0.083). The particle-coating technique consists of suspending the latex in pure absolute ethanol containing lecithin, at room temperature, until a surface film of lecithin begins to form. The latex particles are then washed repeatedly in buffer solution and electrophoretic mobilities determined at 25 ± 0.1°.

Commercial egg lecithin and synthetic L-α-lecithin were used in addition to purified L-α-lecithin[2] to coat the latex. Protein coating experiments were performed by suspending latex or latex-lecithin particles in phosphate-sucrose buffer containing 0.5% bovine gamma globulin at room temperature for 1 hour, followed by repeated washings in buffer solution and cell electrophoresis determinations.

The results, summarized in Table I, reveal the following findings: (*a*) egg lecithin increases latex electrophoretic mobility, synthetic lecithin slightly decreases mobility, and pure lecithin markedly decreases mobility; (*b*) gamma globulin decreases latex-lecithin mobilities, and, with pure lecithin, decreases the mobility below that found with latex-protein alone. Analysis of the commercial synthetic L-α-lecithin revealed the presence of phosphorus-containing impurities,[3] thus accounting for the rather high mobilities obtained with this compound.

TABLE I.—ELECTROPHORETIC MOBILITIES[a] OF LATEX PARTICLES

Specimen	Electrophoretic Mobilities, u./sec./V./cm.
Uncoated latex	1.85
Latex/γ globulin	0.40
Latex/egg lecithin	2.45
Latex/egg lecithin/γ globulin	1.05
Latex/synthetic lecithin	1.65
Latex/syn. lecithin/γ globulin	0.70
Latex/pure lecithin	0.80
Latex/pure lecithin/γ globulin	0.25

[a] Mean negative mobilities, corrected to viscosity of water at 25°C., have S.D.'s <0.03 based on 20 timings per specimen.

These findings are consistent with the fact that the polar head of lecithin is a zwitterion with nearly zero net charge at a neutral pH (3) and has low electrophoretic mobility in isotonic saline (4). It is not possible, on the basis of the present experiments, to determine whether variations in degree of lecithin and/or protein coating account for differences in mobilities, whether underlying phosphate charges are capable of "showing through" the protein, or whether the various lecithins change the molecular configuration of the protein. Recent work has discussed the binding of proteins to lipids (3, 5, 6), the effects of various soap and salt concentrations on latex particle electrophoresis (7, 8), and the problems of interpreting surface electrokinetic potentials (9).

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