USE OF ELECTROPHORESIS TO PREDICT COMPLEX COACERVATION

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Electrophoretic measurements of the polyions gelatin and acacia were used to determine the pH range where complex coacervation is likely to occur.

The acacia was of B.P. quality; two types of gelatin were used, Type A (acid processed) Bloom No.256, isoelectric pH 8.3 $\bar{M}n$ (osmometry) 4.7×10^4; and Type B (alkali processed) Bloom No.250, isoelectric pH 4.8, $\bar{M}n$ 4.6×10^4. In order to undertake micro-electrophoresis the polyions were adsorbed onto colloidal silica and suspended in 1 mM NaCl. pH adjustment was made with 1 mM NaOH or HCl. The pH-electrophoretic mobility profiles (Zeta-meter) at 25°C were determined for the following polyions: acacia (0.02%); gelatin Type A (0.02%); gelatin Type B (0.02%); acacia (0.01%) + gelatin Type A (0.01%); acacia (0.01%) + gelatin Type B (0.01%); and gelatin Type A (0.01%) + gelatin Type B (0.01%). The electrical equivalence pH (E.E.P.) i.e. the pH value where two polyions have an equal and opposite charge was obtained for each of the three polyion combinations, from the individual polyion mobility profiles and have the following values: acacia + gelatin Type A, pH 3.8; acacia + gelatin Type B, pH 3.6; and gelatin Type A + gelatin Type B, pH 5.4. The respective electrophoretic mobilities of the individual polyions at the E.E.P. for the above combinations were 1.6, 1.5, and 0.5 ($\mu m\ s^{-1}\ V^{-1}cm$). The E.E.P. values agreed with the pH values of the polyion mixtures at zero electrophoretic mobility.

Following the work of Veis (1970) on gelatin Type A and B coacervation, the pH for optimum coacervation should be at the E.E.P. The coacervate volume should decrease on either side of this pH and reach zero when the polyions no longer have opposite charges. Figure I shows the effect of pH on the coacervate volume of acacia with gelatin Type A and Type B at 40°C.

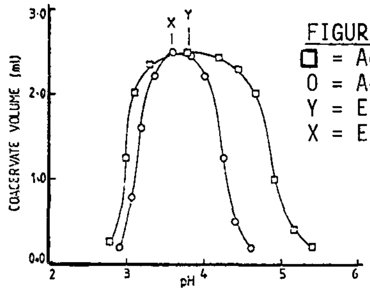

FIGURE 1
□ = Acacia (2%) + gelatin Type A (2%)
O = Acacia (2%) + gelatin Type B (2%)
Y = E.E.P.of acacia and gelatin Type A
X = E.E.P.of acacia and gelatin Type B.

The coacervate volume changes can be related to the changes in the electrophoretic mobility profiles of the polyions. The maximum coacervate volume and the maximum yield of dried microcapsules formed from these coacervates in both cases occurred at the E.E.P. The small electrophoretic mobility at the E.E.P. of the gelatins A + B indicated that coacervation was unlikely by electrostatic charge effects alone. Coacervation of gelatin and acacia did not occur when the electrophoretic mobility of one of the components had reached a value as low as this. Experiments using temperature drop to aid coacervation of the two gelatins have shown that coacervation was still confined within the pH range where the polyions have opposite charges.

These preliminary results show that microelectrophoresis is a useful tool in predicting optimum conditions for producing complex coacervates for microencapsulation.

Veis, A. In Biological Polyelectrolytes Vol.III p.228 ed.A.Veis. M.Dekker,Inc. New York (1970).

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