THE EFFECT OF POLYISOBUTYLENE ON THE COACERVATION OF ETHYL CELLULOSE AND THE FORMATION OF MICROCAPSULES

M. Donbrow and S. Benita, Pharmacy Department, School of Pharmacy, Hebrew University, Jerusalem, P.O.B. 12065, Israel

From the literature on the coacervation of ethyl cellulose (EC), it is not clear if the addition of a protective colloid is necessary in the process of microencapsulation (Miller & Anderson, 1964; Jalsenjak & others, 1976). Our intention was to clarify the effect of polyisobutylene (PIB), a synthetic macromolecule highly soluble and solvated in cyclohexane, on the coacervation of EC. This was effected from cyclohexane solutions cooled slowly from 80° to 25° with controlled agitation. Phase separation over 24 hrs yielded a clear PIB-containing upper phase and a lower phase of coacervate droplets, the volume of which was measured (Table 1A).

Table 1(A) Effect of PIB on the EC coacervation volume (EC conc. 5% w/w). (B)Effect of PIB on the release rate (first order) of salicylamide from microcapsules (EC conc. 5% w/w; salicylamide conc. 5% w/w, mesh 200-300).

PIB	A) EC coacervate		B) EC-salicylamide microcapsules		
% w/w	Total vol ml	Coacervate vol ml	Salicylamide content %	Rate hr^{-1}	Corr. coeff.
0	130	20	47.6	0.482	0.965
3	120	48	-	-	-
7	122	59	51.5	0.091	0.999
8	121	68	90.0	0.675	0.999
9	121	86	95.0	1.083	0.995
10	121	121	-	-	-

The coacervation volume increased non-linearly with PIB concentration and linearly with EC concentration and agitation rate, other parameters being kept constant. The particle size of the coacervate droplets was independent of EC concentration, but decreased with phase coacervation volume increase effected by change in PIB concentration or agitation rate. (EC increases the phase volume by a simple mass increase effect.) The rise in phase coacervation volume with PIB concentration or agitation rate is thus due to increase in the volume of adsorbed solvated PIB. The dense adsorbed layer ensures that pseudo elastic collisions of droplets occur, rather than mixing of their solvated PIB layers and agglomeration (Bagchi, 1973). PIB acts as a protective colloid in the coacervation process preventing the formation of large agglomerates of EC. EC coacervated with PIB formed a free-flowing powder on drying, whereas an aggregated mass was produced in the absence of PIB, which was forced through a mesh 10 sieve. By means of Scanning Electron Microscopy, it was shown that significant differences exist between the surface characteristics of the EC particles coacervated with and without PIB, the latter resembling pure EC.

Salicylamide microcapsules were made by coacervation of EC using the same conditions. Release of salicylamide measured spectrophotometrically using a modified U.S.P. dissolution apparatus follows first order kinetics (Table 1B). Increase of release rate with PIB concentration parallels the increase in salicylamide content due to the thinner EC coating. The thin-walled microcapsules are increasingly accompanied by small empty EC coacervate droplets, separable by repeated decantation. The ability of the latter to coat larger particles of salicylamide is reduced. The parameters which affect the variation of the coacervate volume strongly influence the process of microencapsulation and determine the properties of the microcapsules formed.

Bagchi, P.I.(1973). J. Colloid Interface Sci., 47, 86-99.
Jalsenjak, I., Nicolaidou, C.F. & Nixon, J.R. (1976). J.Pharm.Pharmac.,28,912-914.
Miller, R.E. & Anderson, J.L. (1964). U.S.Pat. No. 3155590.