THE STABILIZATION OF INTRAVENOUS FAT EMULSIONS USING PHOSPHOLIPIDS. THE EFFECT OF MINOR COMPONENTS

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Oil in water emulsions of certain vegetable oils (eg soybean oil) are widely used in parenteral nutrition. The favoured emulsifying agent is purified egg lecithin. This material is a mixture of phospholipids, the major components being phosphatidylcholine (PC) and phosphatidylethanolamine (PE). We have studied the effect on stability of altering the proportions of PC and PE as well as the effects of minor components such as lysolecithin (LL), cholesterol (CH), phosphatidic acid (PA), phosphatidylinositol (PI), phosphatidylserine (PS) and sphingomyelin (SP). The various mixed phospholipid systems were prepared from the individual purified components. A variety of physicochemical methods were used to study the properties of the phospholipid mixtures at the oil/water interface (interfacial tension, coalescence of single droplets, electrophoretic mobility). Emulsions were prepared using sonication, and stability was determined under different test conditions (autoclaving, centrifugation, shaking, freeze-thaw cycling, shelf storage) by particle size analysis, light scattering and Coulter Counter. The emulsions prepared using mixtures of pure PC and PE were unstable. The addition of minor components led to altered interfacial properties and an improved stability. However, correlations between interfacial and stability data were not impressive except for the case of electrophoretic mobility. LL was clearly the most effective minor component in all tests. PA, PS and PI were also effective in producing emulsions with acceptable stability characteristics. The adsorption of the minor components at the o/w interface is thought to be an essential feature of their stabilising effect. The present studies indicate that it will be difficult to predict the stabilising capacity of a given lecithin sample from a knowledge of its major and minor components.

Table 1. Effect of minor components on the properties of the soybean oil/water interface.

PROPERTY	MINOR COMPONENT Nil	CH	PI	PS	SP	PA	LL
Interfacial Tension (mNm^{-1})							
PC : PE ratio 4:1 at 10^{-4} mol dm^{-3} Minor components at 1×10^{-2} g dm^{-3} Age of interface = 5 minutes	40.2	36.5	37.2	42.2	40.9	37.5	27.5
Single Droplet Stability							
(Time 50% coalescence, sec) PC : PE ratio 4:1 at 10^{-4} mol dm^{-3} Minor component at 2×10^{-2} g dm^{-3}	7.7	5.9	7.6	8.8	26.6	5.0	89.2
Microelectrophoretic mobility at pH 7.0							
($\mu m\ sec^{-1} . v^{-1} . cm^{-1}$.) 10% Phase volume emulsions prepared from 1.2% lecithin. Minor component at 0.1%	1.9	2.7	2.8	2.5	2.3	2.7	3.1
Emulsion Stability							
Formulation of emulsions as above. Assessment based on 5 different methods.	-	-	+	+	-	+	++

(- unstable, + stable in majority of tests, ++ stable in all tests).