The effect of solvent on the hydrogel composed of a hydrogenated lecithin and fatty alcohol

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Hydrogels formed by various combination of amphiphilic molecules are widely used for the formulations of skin moisturizing creams and hair conditioners in the cosmetic and pharmaceutical industries. Recently, we found that the ternary system of a crude hydrogenated lecithin (PC70), hexadecanol (HD) and water forms a novel type of hydrogel, and proposed a new gelation mechanism that water continuum surrounding homogeneously distributed charged bilayer sheets works as the structural network in the hydrogel [1,2]. In order to make efficient use of the PC70/HD hydrogel as commercial products, we need to clarify the solvent effect on the gelation because the solvent such as polyol and alcohol, which must be added to almost all cosmetic and pharmaceutical products for the purpose of moisturization or preservation, often causes serious damage to the hydrogel formation. Hence, we investigated the effect of solvent on the structures and physicochemical properties of the PC70/HD hydrogel by optical microscopy, freeze-fracture electron microscopy, synchrotron X-ray diffraction and differential scanning calorimetry. We found that the addition of a solvent with a low dielectric constant to the PC70/HD/water system caused disintegration of the hydrogel, a decrease in the chain-melting phase transition temperature and a change in lamellarity of the PC70/HD bilayers. Moreover, the disintergation of the hydrogel was closely related to the formation of large flat stcked bilayers. In the absence of additional solvent, the hydrogel is formed as a result of the homogeneous distribution of bilayer sheets throughout the solution because the bilayer has a surface charge derived from the charged lipids in the PC70 as described in the previous study [1]. Calculation of the interbilayer interaction energy based on the DLVO theory suggested that the reduction of the aqueous medium dielectric constant may lower the energy barrier preventing flat bilayers from coming closer together, leading to the disintegration of the hydrogel.

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