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An Actualized Survey of Micellar Cholesteric Lyophases

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The present paper gives a review of the cholesteric micellar lyophases mentioned in the literature up to 1988, including those earlier published by Forrest. Intrinsic and induced cholesteric systems have been listed separately. The phases are classified according to their chemical composition. The cholesteric type related to magnetic properties is indicated whenever available.

INTRODUCTION

The number of cholesteric phases found in micellar solutions is currently increasing. Radley and Saupe first discovered that nematic lyophases from amphiphiles became cholesteric when chiral solutes were added.[1] Later Acimis and Reeves found that cholesteric lyophases could also be obtained from chiral amphiphilic molecules.[2]

RESULTS AND DISCUSSION

Induced and intrinsic cholesteric solutions have been listed separately in Table I and Table II. The data published up to 1988 are given and they include the references contained in the paper of Forrest which was published in 1981.[3]

We have further grouped the systems, in columns according to their chemical composition, in line with the principle we previously followed in the classification of nematic lyophases.[4] The columns represent the following: (1) amphiphile + water; (2) amphiphile + water + electrolyte; (3) amphiphile + water + cosurfactant; (4) amphiphile + water + electrolyte + cosurfactant (cosurfactant: long chained alcohol). The columns (1) and (3), in Table II, are empty for the moment.

The cholesteric lyophases can be oriented in a magnetic field. They have been defined as Chol I, when the screw axis orientation is perpendicular to the field and Chol II, when the orientation is parallel.[5] The magnetic type of each system has been specified whenever reported by the authors.

The known micellar cholesteric lyophases all seem to have parent nematic lyophases. On the one hand, the cholesteric state is induced in nematics by chiral

TABLE I

Induced cholesteric lyomesophases

Amphiphile, counterion	Chiral solute	[1]	[2]	[3]	[4]
Cromoglycate, $2Na^+$	*l*-alanine	Chol II[9]			
	l-alanine + *d*,*l*-alanine + various solutes[a]	Chol II[23,26]			
Decylammonium, Cl^-	cholesterol		Chol II[5,21] Chol[11]		
Decylsulphate, Na^+, Cs^+, NH^+	cholesterol		Chol I[5]		
	brucine, cinchonine, tartaric acid				Chol II[28]
	brucine sulphate			Chol[15]	Chol II[1]
	tartaric acid			Chol II[1]	
	diacetone *l*-sorbose				Chol II[21]
	tartaric acid + glycine		Chol I[5]		
	cholesterol + glycine		Chol I[5]		
Decylsulphate + Decyl-2-sulphate, Na^+	*d*-alanine or *d* + *l* alanine				Chol[25]
Laurate, K^+	cholesterol		Chol I[5,6,19]	Chol II[24]	Chol II[5,6,19,27]
	cholesterol + glycine		Chol I[5]		
d, *l*-N-Lauroylalaninate, Na^+	cholchicine				Chol II[12]
l-N-Lauroylalaninate, K^+	alanine				Chol[14]
d, *l*-N-Lauroylalaninate, K^+	cholchicine or cinchonidine, etc.				Chol II[8,16]
	brucine		Chol II[17]		Chol II[16]
d, *l*-N-Lauroylalaninate, K^+ + Lauroylsarcosinate, K^+	brucine		Chol II[17]		Chol II[16]
Lauroylsarcosinate, Na^+	brucine		Chol II[17]		
l-N-Lauroylsarcosinate, K^+	cholesterol				Chol II[5]
l-N-Lauroylserinate, K^+	cholesterol				Chol II[5]

[a]28 various enantiomers of amino acids or their hydrochlorides.

TABLE II

Intrinsic cholesteric lyomesophases

Amphiphile, counterion	[2]	[4]
l-Alanine decyl ester hydrochloride, Cl^-	Chol II[2]	
d-Alanine decyl ester hydrochloride, Cl^-	Chol II[2]	
l-N-Lauroylalaninate, K^+		Chol II[8,10] Chol I[10] Chol[14,22]
l-N-Lauroylalaninate, Na^+		Chol II[11]
d+*l*-N-Lauroylalaninate,K^+		Chol II[8,16]
l-N-Lauroylalaninate,K^+ + *d*,*l*-N-Lauroylalaninate,K^+		Chol II[16]
l-N-Lauroylalaninate,K^+ + Tetradecyltrimehylammonium,Br^-		Chol[22]
l-N-Lauroylaspartate, $2Na^+$		Chol I[18,20] Chol II[18,20]
l-N-Lauroylaspartate + *d*,*l*-N-Lauroylaspartate,$2Na^+$		Chol II[18]
l-N-Lauroylserinate,K^+		Chol I[29] Chol II[13] Chol[8]
d-N-Lauroylserinate,Na^+,K^+		Chol II[11]
d+*l*-N-Lauroylserinate,K^+		Chol II[16]
l-N-Lauroylserinate,K^+ + *d*,*l*-N-Lauroylserinate,K^+		Chol I[29] Chol II[13]
d-N-Lauroylserinate + *l*-N-Lauroylalaninate,K^+,Na^+		Chol II[11,12,16]
l-N-Hexadecanoylprolinate,K^+		Chol[22]
l-N-Hexadecanoylprolinate,K^+ + Tetradecyltrimethylammonium,Br^-		Chol[22]
d+*l* Lauroylvalinate,K^+		Chol II[16]

solutes with varying twisting power.[7] On the other hand, nematic phases have been reported, in most cases, when the optically active amphiphiles, in the intrinsic systems, were replaced by the racemates.

The Chol II type is generated from N_D^- and also from N_C^- (cromoglycate) nematic phases. The Chol I type arise from N_C^+ nematics. We conclude that the screw axis is perpendicular to the symmetry-axis of the nematic aggregates. To date, no cholesteric phases have been reported from parent N_D^+ nematics.

CONCLUSION

Micellar solutions and nematic lyophases from amphiphilic compounds have proved themselves useful as membrane models. The recently discovered cholesteric lyophases introduce new properties in these model systems. They can be considered as an approach to cholesteric lyophases from polypeptides and biological material.

Our intention is to follow up new informations on this subject and to periodically revise our tables.

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