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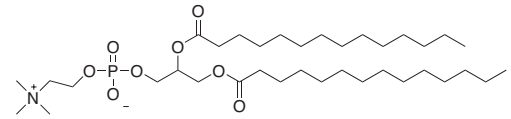
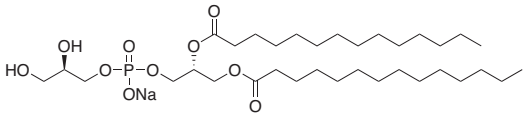
Technical Bulletin 121

Bicelles

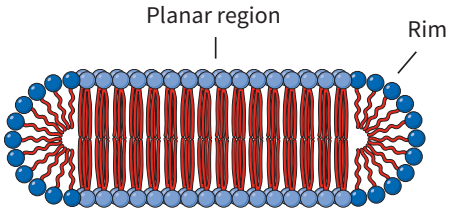
Bicelles are disk-shaped aggregates composed of long-chain phospholipids that make up a planar region and either detergent or short-chain phospholipids that compose flanking rims. The size of bicelles is regulated by adjusting the lipid/detergent ratio and the surface charge can be manipulated by replacing neutral long-chain lipids with phospholipids that have similar diacyl chain lengths but negatively charged headgroups.



DMPC



DMPG



Schema of bicelle structure

Benefits of using bicelles

Bicelles are the next generation of biological membrane models that allow a closer look at the structure, dynamics, and topology of membrane proteins. Bicelles have an advantage over micelles in their ability to mimic natural membranes and, therefore, capture membrane proteins in their biologically relevant orientation as demonstrated in structural studies of the transmembrane segment of Integrin β3[1] and functional studies of DAGK[2]. Since the introduction of bicelles for NMR studies of membrane-associated biomolecules[3], a wide variety of uses in membrane protein science, including solution and solid-state NMR and crystallization studies, have emerged.

The ability of bicelles to spontaneously align in a magnetic field has enabled their use in solid-state NMR studies to characterize GPCRs, the trans-membrane domain of Vpu from HIV-1, and cytochrome b(5) to name a few[4]. Bicelles can be made small to attain tumbling times suitable for solution NMR which has been used to investigate human dynorphin A' and B's positions and interaction features in the membrane[5]. More recently, bicelles were used to solve the solution NMR structure of the Bnip3 transmembrane domain dimer revealing that bicelles could facilitate analysis of proteins with more than a single transmembrane helix[6]. Bicelle crystallization was first demonstrated with bacteriorhodopsin from *H. salinarum*[7] and has since been used in studies with xanorhodopsin[8], the voltage gated anion channel and the β_2-adrenergic G-protein-coupled receptor[9].

Anatrace® bicelle products

Anatrace offers lipids and detergents that are highly purified to >99% and can be mixed to form bicelles for membrane protein applications. The zwitterionic long-chain phospholipid, DMPC, and negatively charged long-chain phospholipid, DMPG, are offered in addition to CHAPS and CHAPSO to support virtually any bicelle application. Both DMPC/CHAPS and DMPC/CHAPSO bicelles have been used directly in crystallization studies and the lipid/detergent bicelles have been shown to impart better stability and density definition in comparison to bicelles rimmed with short-chain phospholipids[8,10].

D399-BIC **Bicelle Kit**

Kit contains two lipids and two detergents: 200 mg DMPC, 200 mg DMPG, 1 gm CHAPS, and 1 gm CHAPSO.

C316 **CHAPS, Anagrade®**

[3-[(3-Cholamidopropyl)-Dimethylammonio]-1-Propane Sulfonate] • N,N-Dimethyl-3-Sulfo-N-[3-[[3α,5β,7α,12α)-3,7,12-Trihydroxy-24-Oxo-cholan-24-yl] Amino]propyl]-1-Propanaminium Hydroxide, Inner Salt]

Chemical Properties:

FW: 614.9 [75621-03-3] $C_{32}H_{58}N_2O_7S$

CMC (H_2O): ~ 8 mM[11] (0.49%)

Aggregation number (H_2O): ~ 10[12]

dn/dc (H_2O): 0.1323 ml/gm[13]

Product Specifications:

Purity: ≥ 99% by HPLC analysis

pH (1% solution in water): 5-8

Solubility in water at 20°C: ≥ 0.5 M

Conductance (0.5 M solution in water): < 50 µS

Percent fluorescence due to a 0.1% solution in water at 345 nm: < 10

Absorbance of a 1% solution in water:

340 nm: < 0.02

280 nm: < 0.04

260 nm: < 0.06

C317 **CHAPSO, Anagrade**

[3-[(3-Cholamidopropyl)dimethylammonio]-2-Hydroxy-1-Propanesulfonate]

Chemical Properties:

FW: 630.9 [82473-24-3] $C_{32}H_{58}N_2O_8S$

CMC (H_2O): ~ 8 mM[11] (0.50%)

Aggregation number (H_2O): ~ 11[11]

Product Specifications:

Purity: ≥ 99% by HPLC analysis

pH (1% solution in water): 5-8

Solubility in water at 20°C: ≥ 0.5 M

Conductance (0.5 M solution in water): < 100 µS

Percent fluorescence due to a 0.1% solution in water at 345 nm: < 10

Absorbance of a 1% solution in water:

340 nm: < 0.02

280 nm: < 0.04

260 nm: < 0.06

D514 **1,2-Dimyristoyl-sn-Glycero-3-Phosphocholine**

[DMPC]

Chemical Properties:

FW: 677.9 $C_{36}H_{72}NO_8P$

Product Specifications:

Purity: ≥ 99% by HPLC analysis

pH (1% solution in methanol): 5-8

Solubility: Methanol: > 20%

Practically insoluble in water

Conductance (1% solution in methanol): < 200 µS

Absorbance of a 1% solution in methanol:

340 nm: < 0.02

280 nm: < 0.08

260 nm: < 0.1

D614 **1,2-Dimyristoyl-sn-Glycero-3-[Phospho-rac-(1-Glycerol)] (Sodium Salt)**

[DMPG]

Chemical Properties:

FW: 688.9 $C_{34}H_{66}NaO_{10}P$

Product Specifications:

Purity: ≥ 99% by HPLC analysis

pH (1% solution in water): 5-8

Solubility: Water: > 1%

MeOH soluble with heat

Absorbance of a 1% solution in water:

340 nm: < 0.02

280 nm: < 0.08

260 nm: < 0.1

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13. Measurement obtained in collaboration with Professor Mark Foster (University of Akron) under an experimental services contract.

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