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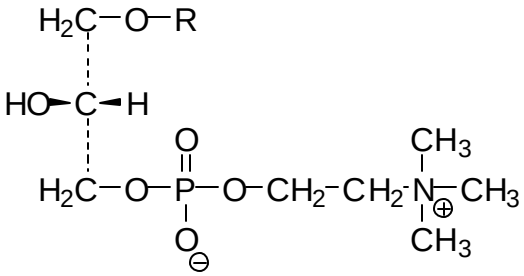
L-α-LYSOPHOSPHATIDYLCHOLINE
Product Number **L3010, L3135, L5629, L6629, L5254, L5257, L2131, L1881, L4129, L3013, L0906, L1381 and L5004**
Storage Temperature -0°C

Synonyms: LPC, lysolecithin, 1-O-acyl-sn-glycero-3-phophocholine, L-α-lysophosphatidylcholine-gamma-O-acyl

Product Description



R = Fatty Acid Acyl Chain

LPC products are prepared by the enzymatic action of phospholipase A-2[1,2] on the respective tissue or diacyl L-α-phosphatidylcholine. Products are purified using chromatographic and solvent partition technology. Substitution at the gamma (γ) or 1 position, depending on the nomenclature system used, would define the structure. The fatty acid content of the individual products is shown in Table I. A natural source LPC, such as from brain, may contain traces of 1-O-alkyl substitution and related structures.[3]

Molecular weights (Table I) are calculated based on an internal salt between the phosphate O^- and the choline N^+ functional groups. A transition temperature has been reported for palmitoyl LPC (3.0+/-0.2°C).[4] The pKa for the phosphate group would be expected to lie in the pH range of 0 to 2.[4]

The LPC products are supplied as amorphous powders except L0906, which is a lyophilized powder, and L3013, which is a chloroform solution. Purities for most LPC products, including synthetic LPC with a single fatty acid, are not less than 98.5% by both gas chromatography and thin-layer chromatography. For natural source LPC with several fatty acids present in the gamma (γ) position, purity by TLC is usually approximately 99%.

Critical Micelle Concentration (CMC) information is provided in Table I. Although the CMC of LPC derived from egg yolk is 20-200 micromolar[5], the major components of egg LPC have reported CMC values[6,7,8,9,10,11] of 2.9 to 8.4 micromolar and 0.25 to 0.4 micromolar for the palmitic and stearic acid species, respectively. The aggregation number of egg LPC is reported as 191 with a molecular weight of 95,000.[12] At the higher concentrations of egg LPC (1 to 2%, w/v), larger micelles (approximately 270 molecules) have been observed.[5]

CMC values depend on the conditions of measurement. LPC containing pure palmitic acid forms small micelles with Stokes radius of 34 angstroms between 7 and 50 micromolar.[9] At approximately 50 micromolar, a transition occurs to a larger size micelle with a 72 angstrom Stokes radius.[9] The average aggregation number of a palmitoyl LPC micelle is reported as 139.[13]

LPC occurs in biological membranes at low concentrations. LPC is involved in phospholipid turnover in cell membranes and in recycling of phosphatidylcholine after the action of phospholipase A2. It is a bioactive lipid, which has been studied in a variety of signal transduction processes. LPC is a major component of oxidized low density lipoproteins, and has been implicated in various inflammatory reactions, including atherosclerosis.[14,15] It is used to demyelinate spinal neurons and study the processes underlying remyelination.[16] It activates protein kinase C,[17,18] p38 MAP kinase,[18] p42 MAP kinase,[18] and the jun kinase (JNK) pathway, and stimulates transcription of c-jun.[19] Lysophosphatidylcholine accumulates during cardiac ischemia and may induce arrhythmias by uncoupling gap junction communication,[20] and increase ischemic damage by enhancing Na^+ loading in cardiac myocytes. It also activates TREK1, TREK2 and TRAAK K^+ Channels.[22,23]

LPC is used as a detergent to study membrane processes.[10] While the exact mechanism of action is uncertain, LPC replaces phospholipids in the membrane bilayer with a resultant loss of integrity of the

membrane.[10] High concentrations of LPC lead to cell lysis, while lower concentrations permeabilize the cell surface membranes without complete lysis of the cells.[11,24,25,26,27,28,29] Lytic procedures include studies on erythrocytes,[6,10] other cells[30] and pure lipid membranes.[10] The processes of lysis are studied by techniques such as binding, penetration, membrane disruption, ion permeability and osmotic effects.[10] In some cases these actions may be mediated through secondary actions by lytic enzymes.[30] Lytic actions on erythrocytes related to membrane affinity and perturbation are dependant on fatty acid chain length and degree of unsaturation in the LPC.[9] Lysis of erythrocytes, which lack inner membrane systems, is a unique system for measuring effects on their plasma membranes.[10]

LPC is used as a detergent to produce effects on cell-fusion of membranes.[10,31,32] Fusion and lytic actions are usually found to occur in a close range of concentrations.[10]

For permeabilization of cells by LPC, concentrations from 0.005% to 1% have been used. The lower concentrations of 0.005% to 0.25% are effective with better cell viability, while higher concentrations result in reduced viability.[6,25,26,28,29,33] Permeabilization of membranes is produced by exposure to LPC for short periods of time. Permeabilization studies use times ranging from 1 to 30 minutes at temperatures of either 4°C[25,28,33] or 37°C[6,26,29] for incubation with the LPC. The LPC is removed and the cells are further studied. Uptake of compounds of interest can be studied using these cells, which are not completely lysed. HL60 leukemic cells were permeabilized and fixed with 5 – 40 micrograms LPC in 1% paraformaldehyde. Optimum movement of antibodies to the cell interior occurred at a concentration of 40 micrograms LPC per ml.[33] Alternatively, the cells can be permeabilized with 50 micrograms LPC per ml in PBS. The cells are then washed twice by centrifugation with PBS, pH 7.2, containing 1% BSA.

Storage/Stability

Stable as supplied for up to 1 year at -0°C, based on TLC analysis. Monounsaturated fatty acids would be subject to oxidation, if the product is submitted to oxidizing conditions.[34] The presence of fatty acids with multiple double bonds would significantly increase the potential for oxidation, occurring at the methylene carbon located between the double bonds.[34] To protect double bonds from oxidation, storage under nitrogen or argon is recommended.

The presence of choline contributes to the hyroscopic nature of this product in the solid state. Protection from moisture is necessary. Uptake of moisture can change the appearance to a more waxy or gum-like nature.

Solubility is usually tested at 25-50 mg per ml in chloroform:methanol (1:1, v/v) for synthetic LPC and/or chloroform for natural source LPC. Solubilities of egg LPC (g/100 mL) at 25°C have been reported in ethanol (3.9), chloroform (27.8), methanol (14.6), acetone (0.02), diethyl ether (0.002) and petroleum ether (0.02).[3] Short chain fatty acid LPC have been assayed at 25-50 mg per ml in chloroform (L3010) or chloroform:methanol (9:1, v/v) (L3135). Slight warming (40°C) will aid solubility.[5]

For preparations of solutions of unsaturated LPC, it may be beneficial to deoxygenate the solvents for extended storage. Solutions should be stable at neutral pH conditions, if suitably protected form oxidation. Freezer storage is recommended.

Partial acyl migration from the gamma (γ or 1)[1] position to the beta (β or 2)[2] position may be possible under certain non-neutral pH conditions, such as demonstrated with the formation of an equilibrium mixture of 1,2 and 1,3-diglycerides in acidic or basic solutions.[35]

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Table I

PROPERTIES OF LYSOPHOSPHATIDYLCHOLINES				
Product Number (1)	Acyl Chain Length (1)	Molecular Weight	CMC Moles/liter	References
L3010	6:0	355.4[1]	6×10^{-2}	24
L3135	10:0	411.5[1]	$2\text{-}7 \times 10^{-3}$	10,24,29
L5629	12:0	439.5[1]	$2\text{-}7 \times 10^{-4}$	6,10,24,29
L6629	14:0	467.6[1]	$2\text{-}7 \times 10^{-5}$	6,10,24,29
L5254	16:0	495.6[1]	$2\text{-}8 \times 10^{-6}$	6,7,8,9,10,24,29
L5257	17:0	509.7[1]		
L2131	18:0	523.7[1]	$2\text{-}4 \times 10^{-7}$	6,7,10,24
L1881	18:1	521.7[1]	2×10^{-6}	6,
L4129	egg	505[2]	$2\text{-}20 \times 10^{-5}$	26,29
L3013	soy	513[3]		
L0906	soy	513[3]		
L1381	brain	506[4]		
L5004	liver	515[5]		

1. Sigma catalog listing.
2. Based on usual fatty acid contents of approx. 66% palmitic and 33% stearic acids. Other trace fatty acids would be expected.
3. Based on usual fatty acid contents of 40-60% linoleic, 25-30% palmitic, 10-12% oleic, 7-10% stearic and 4-6% linolenic acids.
4. Based on usual fatty acid contents of 60-65% palmitic, 25-27% stearic and 6-8% oleic acids. Alk-1-enyl (plasmalogen) molecular species content is approximately 60%. 1-O-Alkyl molecular species as well as double bond positional isomers of octadecenoic acid may be present.[25]
5. Based on usual fatty acid contents of 25-30% palmitic, 60-70% stearic and 2-4% oleic acids.