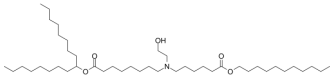
SM-102

Cat. No.:	HY-134541
CAS No.:	2089251-47-6
Molecular Formula:	$C_{44}H_{87}NO_5$
Molecular Weight:	710
Target:	Liposome
Pathway:	Metabolic Enzyme/Protease
Storage:	Pure form -20°C 3 years 4°C 2 years In solvent -80°C 6 months -20°C 1 month



SOLVENT & SOLUBILITY

In Vitro

Ethanol : ≥ 100 mg/mL (140.85 mM)

DMSO : 100 mg/mL (140.85 mM; Need ultrasonic)

* "≥" means soluble, but saturation unknown.

Preparing Stock Solutions

Solvent / Mass / Concentration	1 mg	5 mg	10 mg
1 mM	1.4085 mL	7.0423 mL	14.0845 mL
5 mM	0.2817 mL	1.4085 mL	2.8169 mL
10 mM	0.1408 mL	0.7042 mL	1.4085 mL

Please refer to the solubility information to select the appropriate solvent.

In Vivo

1. Add each solvent one by one: 10% DMSO >> 40% PEG300 >> 5% Tween-80 >> 45% saline
   Solubility: ≥ 2.5 mg/mL (3.52 mM); Clear solution
2. Add each solvent one by one: 10% DMSO >> 90% (20% SBE-β-CD in saline)
   Solubility: 2.5 mg/mL (3.52 mM); Suspended solution; Need ultrasonic
3. Add each solvent one by one: 10% DMSO >> 90% corn oil
   Solubility: ≥ 2.5 mg/mL (3.52 mM); Clear solution

BIOLOGICAL ACTIVITY

Description

SM-102 is an amino cationic lipid useful in the formation of lipid nanoparticles (LNPs). SM-102 has higher transfection efficiency. SM-102 plays an important role in the effectiveness of lipid nanoparticles (LNPs) in delivering mRNA therapeutics and vaccines[1][2].

In Vitro

Preparation of Lipid Nanoparticles

Here we provide lipid molar ratios for LNPs in FDA-approved mRNA-1273 (a COVID-19 mRNA vaccine). The molar ratio of lipids in this formulation is SM-102 : DSPC : Cholesterol : DMG-PEG 2000 = 50 : 10 : 38.5 : 1.5[1], and RNA to lipid weight ratio is 0.05 (wt/wt).

A. Lipid Mixture Preparation

1. Dissolve lipids in ethanol and prepare 10 mg/m stock solutions. The lipid stock solutions can be stored at −20°C for later use.

Note 1: The ionizable lipid is usually a liquid. Due to the viscosity, it should always be weighed rather than relying on the autopipette volume.

Note 2: Cholesterol in solution should be kept warm (>37⊠) to maintain fluidity. Transfer the cholesterol solution promptly to avoid cooling.

2. Prepare the lipid mixture solution as described. For each mL of lipid mixture add the following: 572 µL of 10mg/mL SM-102 (HY-134541), 240 µL of 10mg/mL cholesterol (HY-N0322), 127 µL of 10mg/mL DSPC (HY-W040193), and 61 µL of DMG-PEG 2000 (HY-112764). Mix the solutions thoroµghly to achieve a clear solution. This mixture contains 10 mg of total lipid.

Note 3: The choice of lipids and ratios may be changed as desired and this will affect the LNP properties (size, polydispersity, and efficacy) and the amount of mRNA required.

B. mRNA Preparation

1. Prepare a 166.7 µg/mL mRNA solution with 100 mM pH 5 sodium acetate buffer.

Note 4: The lipid:mRNA weight ratio influences the encapsulation efficiency. Other weight ratios may be prepared as alternative formulations and should be adjusted accordingly by user.

C. Mixing

There are three commonly used methods to achieve rapid mixing of the solutions: the pipette mixing method, the vortex mixing method, and the microfluidic mixing method. All these mixing methods can be used for various applications.

It is important to note that pipette mixing method and vortex mixing method may yield more heterogeneous LNPs with lower encapsulation efficiencies and is prone to variability. Microfluidic devices enable rapid mixing in a highly controllable, reproducible manner that achieves homogeneous LNPs and high encapsulation efficiency. Within these devices, the ethanolic lipid mixture and aqueous solution are rapidly combined in individual streams. LNPs are formed as the two streams mix and are then collected into a single collection tube.

1. Pipette Mixing Method:

1.1. Pipette 3 mL of the mRNA solution and quickly add it into 1 mL of the lipid mixture solution (A 1:3 ratio of ethanolic lipid mixture to aqueous buffer is generally used.) Pipette up and down rapidly for 20–30 seconds.

1.2. Incubate the resulting solution at room temperature for up to 15 minutes.

1.3. After mixing, the LNPs were dialyzed against PBS (pH 7.4) for 2 h, sterile filtered using 0.2 µm filters, and stored at 4°C.

2. Vortex Mixing Method:

1.1. Vortex 3 mL of mRNA solution at a moderate speed on the vortex mixer. Then, Quickly add 1 mL of the lipid mixture solution into the vortexing solution (A 1:3 ratio of ethanolic lipid mixture to aqueous buffer is generally used.). Continue vortexing the resulting dispersion for another 20–30 seconds.

1.2. Incubate the resulting solution at room temperature for up to 15 minutes.

1.3. After mixing, the LNPs were dialyzed against PBS (pH 7.4) for 2 h, sterile filtered using 0.2 µm filters, and stored at 4°C.

3. Microfluidic Mixing Method:

1.1 The 3 mL of mRNA buffer solution and 1 mL of the lipid mixture solution were mixed at a total flow rate of 12 mL/min in a microfluidic device (A 1:3 ratio of ethanolic lipid mixture to aqueous buffer is generally used.).

Note 5: Parameters such as the flow rate ratio and total flow rate can be altered to fine-tune LNPs.

1.2. After mixing, the LNPs were dialyzed against PBS (pH 7.4) for 2 h, sterile filtered using 0.2 μm filters, and stored at 4°C.

Reference

1. Curr Issues Mol Biol. 2022 Oct 19;44(10):5013-5027.

2. Curr Protoc. 2023;3(9):e898.

MCE has not independently confirmed the accuracy of these methods. They are for reference only.

CUSTOMER VALIDATION

- Nat Nanotechnol. 2023 Jun 26.
- J Biomed Sci. 2023 Jun 28;30(1):46.
- Int J Nanomedicine. 2023 Dec 19:18:7785-7801.
- cell rep methods. 2023 Dec 23:100673.
- bioRxiv. 2024 Feb 5.

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REFERENCES

[1]. Escalona-Rayo O, et al. In vitro and in vivo evaluation of clinically-approved ionizable cationic lipids shows divergent results between mRNA transfection and vaccine efficacy. Biomed Pharmacother. 2023 Sep;165:115065.

[2]. Cho HY, et al. Effective Perturbations on the Amplitude and Hysteresis of Erg-Mediated Potassium Current Caused by 1-Octylnonyl 8-[(2-hydroxyethyl)[6-oxo-6(undecyloxy)hexyl]amino]-octanoate (SM-102), a Cationic Lipid. Biomedicines. 2021 Oct 1;9(10):1367.

[3]. Staci Sabnis, et al. A Novel Amino Lipid Series for mRNA Delivery: Improved Endosomal Escape and Sustained Pharmacology and Safety in Non-human Primates. Mol Ther. 2018 Jun 6;26(6):1509-1519.

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