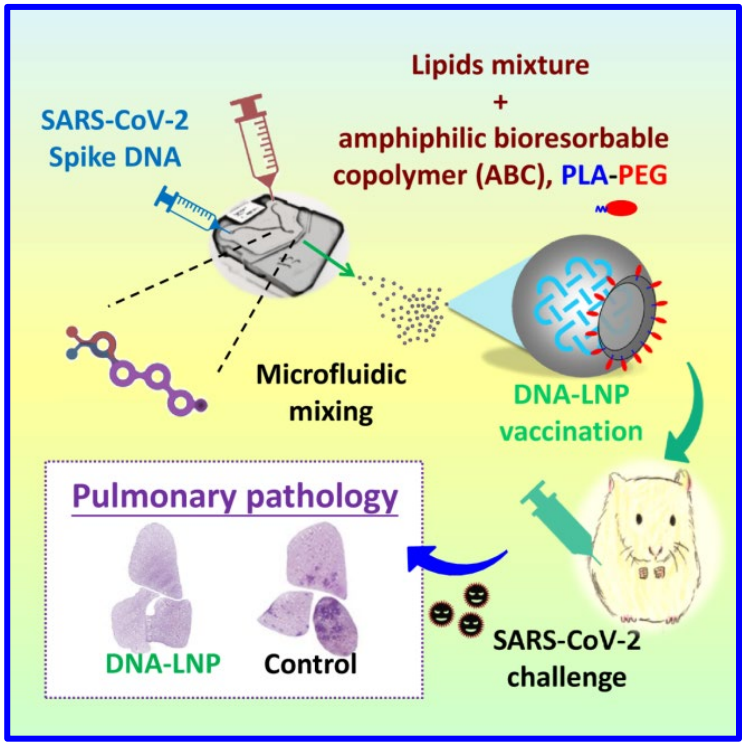
Surface engineering of lipid nanoparticle (LNP) in the pursuit of innovative nucleic acid vaccines and therapeutics



Significance

1. Set up LNP synthesis procedure
   - Journal of Medical Virology, 2023;
   - Molecular Therapy - Methods and Clinical Development, 2024
2. Introduce new concept LNP components
   - Molecular Therapy - Nucleic Acids, 2024;
   - Taiwan patent TW I853485; US and AU patent application
3. Incubate the service platform, "Nucleic Acid Drugs & Raw Materials"

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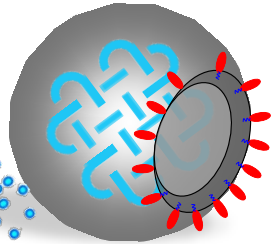
Rational design of nucleic acid vaccines & therapeutics

Lipids mixture
(1)+(2)+(3)+(4)
in ethanol

- **(1)** cholesterol
- **(2)** a helper lipid
- **(3)** a PEGylated lipid
- **(4)** an ionizable cationic lipid

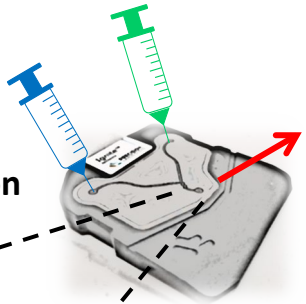


(1) + (2) structural element

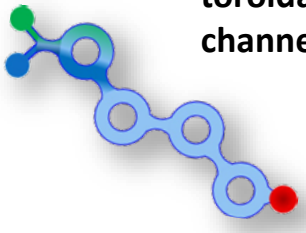
(3) Surface engineering

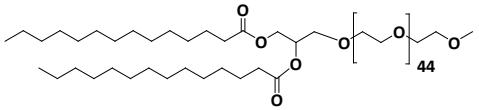
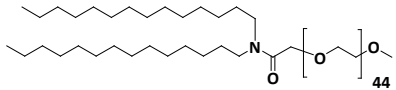
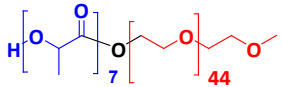
(4) + (5) NA-lipid complexes

(5) Nucleic acid (NA)
in acidic buffer solution



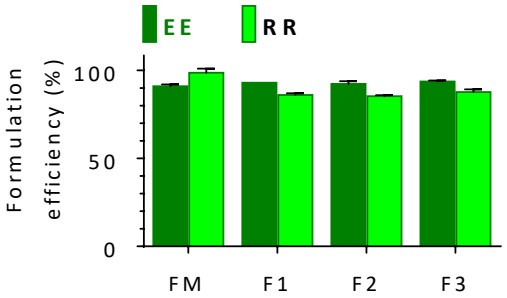
toroidal channel

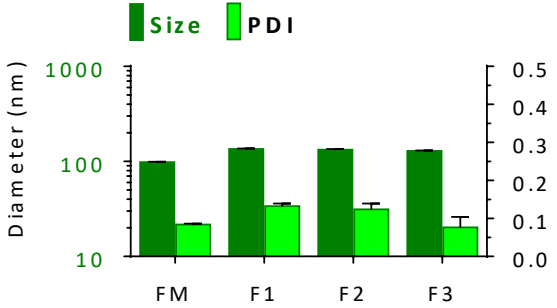


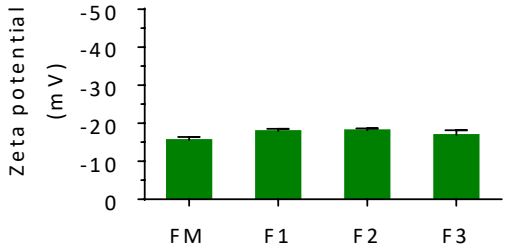
Proprietary	PEGylated lipid	Structure
moderna	DMG-PEG	
BIONTECH Pfizer	ALC-0159	
	ABC	PLA-PEG 

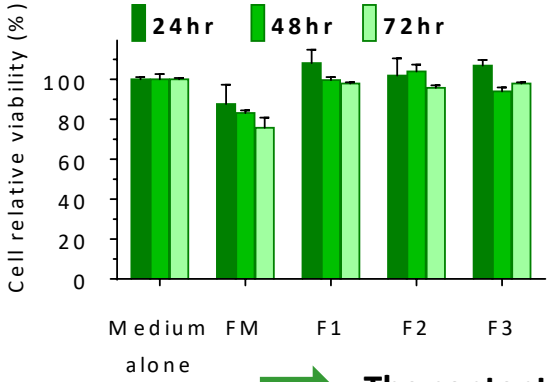
TW I853485; Molecular therapy - nucleic acids, 2024

Nucleic acid-lipid nanoparticle and method using the same









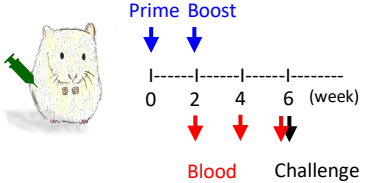
Acronym	Molar ratio of lipids			
	Cholesterol	DSPC	SM-102	PEGylated lipid
DNA-LNP-FM	38.5	10	50	1.5 [a]
DNA-LNP-F1	38.5	10	50	0
DNA-LNP-F2	38.5	10	50	1.5 [b]
DNA-LNP-F3	38.5	10	50	3.0 [b]

[a] PEGylated lipid: DMG-PEG 2000; [b] PEGylated lipid: PLA-PEG 2000

The content of PEGylated lipid plays a crucial rule on the prospective efficiency of LNPs.

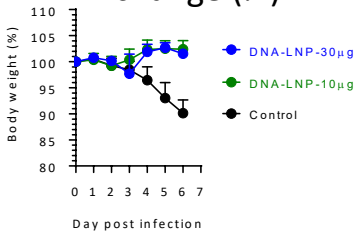
LNP platform technology in COVID-19 DNA vaccine

DNA encoding SARS-CoV-2 Omicron variant spike genes

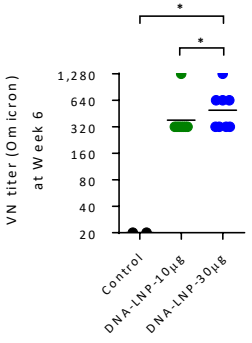


Virus challenge

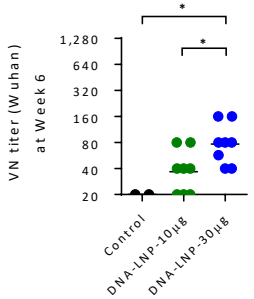
Body weight change (%)



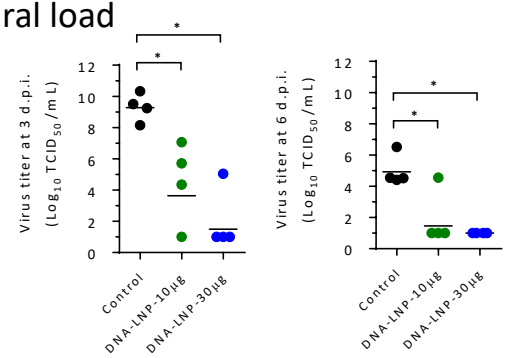
Anti-Omicron



Anti-Wuhan



Viral load

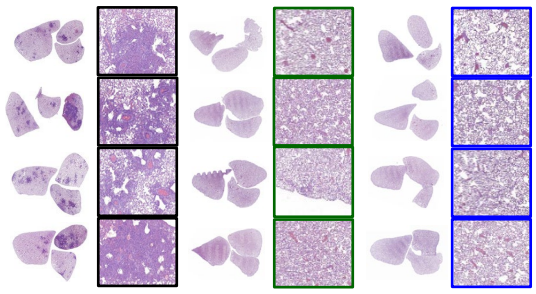


Molecular Therapy Nucleic Acids
Original Article

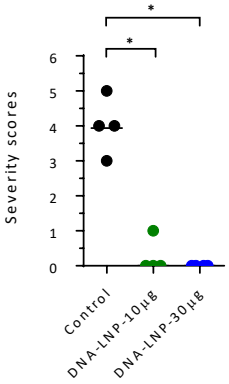
Molecular Therapy - Nucleic Acids. 2024;35(3):102261.

Boosting DNA vaccine power by lipid nanoparticles surface engineered with amphiphilic bioresorbable copolymer

Pathologic examination: H&E

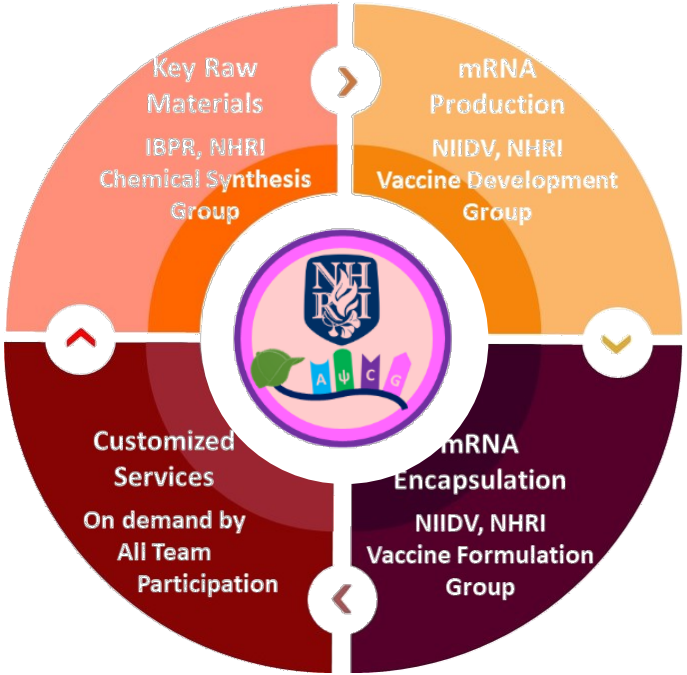


Pathologic score



Nucleic Acid Drugs & Raw Materials Service Platform

National Core Facility for Biopharmaceuticals (NCFB)



Mission Statement

To accelerate academic research, and further contribute positively to domestic companies that want to invest in the nucleic acid drugs, thereby helping to construct an industry chain in Taiwan.

To provide critical raw materials and mRNA synthesis service platforms in lab scale and potential GMP-grade production：

(1) Key raw materials：Dr. Jinq-Chyi Lee (李靜琪), IBPR
Caping molecule & pseudo-uridine (m1ΨTP)

(2) mRNA production：Dr. Shih-Jen Liu (劉士任), NIIDV
in vitro-transcribed (IVT) mRNA synthesized by T7 RNA polymerase-mediated transcription

(3) mRNA encapsulation：Dr. Ming-Hsi Huang(黃明熙), NIIDV
mRNA-LNP self-assemblies using microfluidic mixer system

(4) Customized services：Dr. Chih-Hsiang Leng (冷治湘), NIIDV
On demand by all team participation