

Scope of Non-Lamellar Lipid Systems in Emerging Nano-Formulations

Dr Chandrashekhar V. Kulkarni

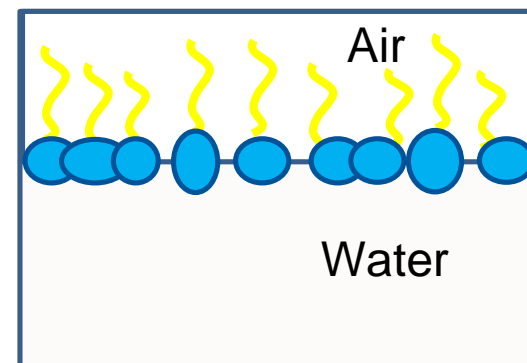
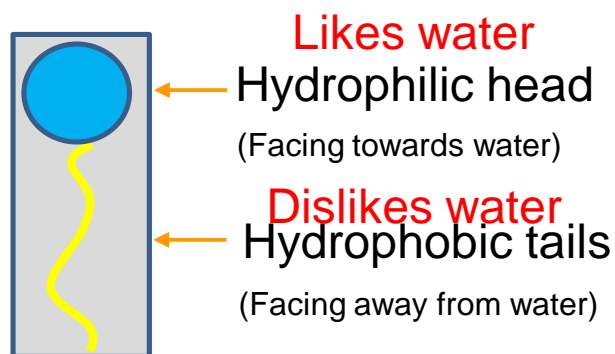
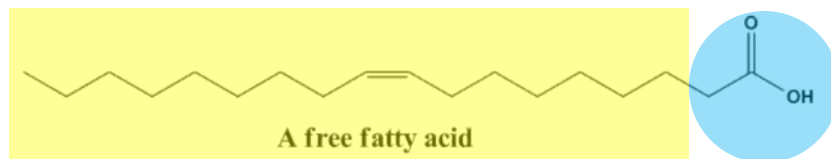
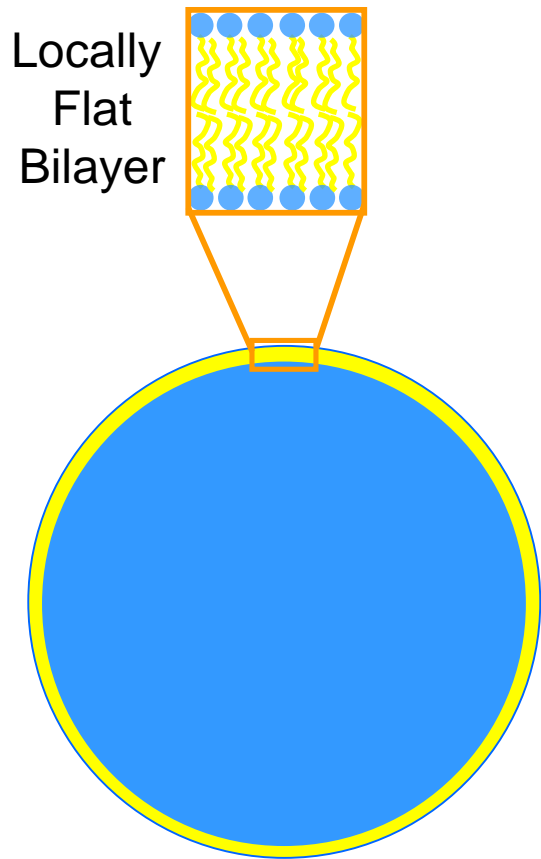
Centre for Smart Materials, School of Natural Sciences,
University of Central Lancashire, Preston, United Kingdom

12th March, 2021

**Formative
Formulation 2**



Lipid Self-assembly



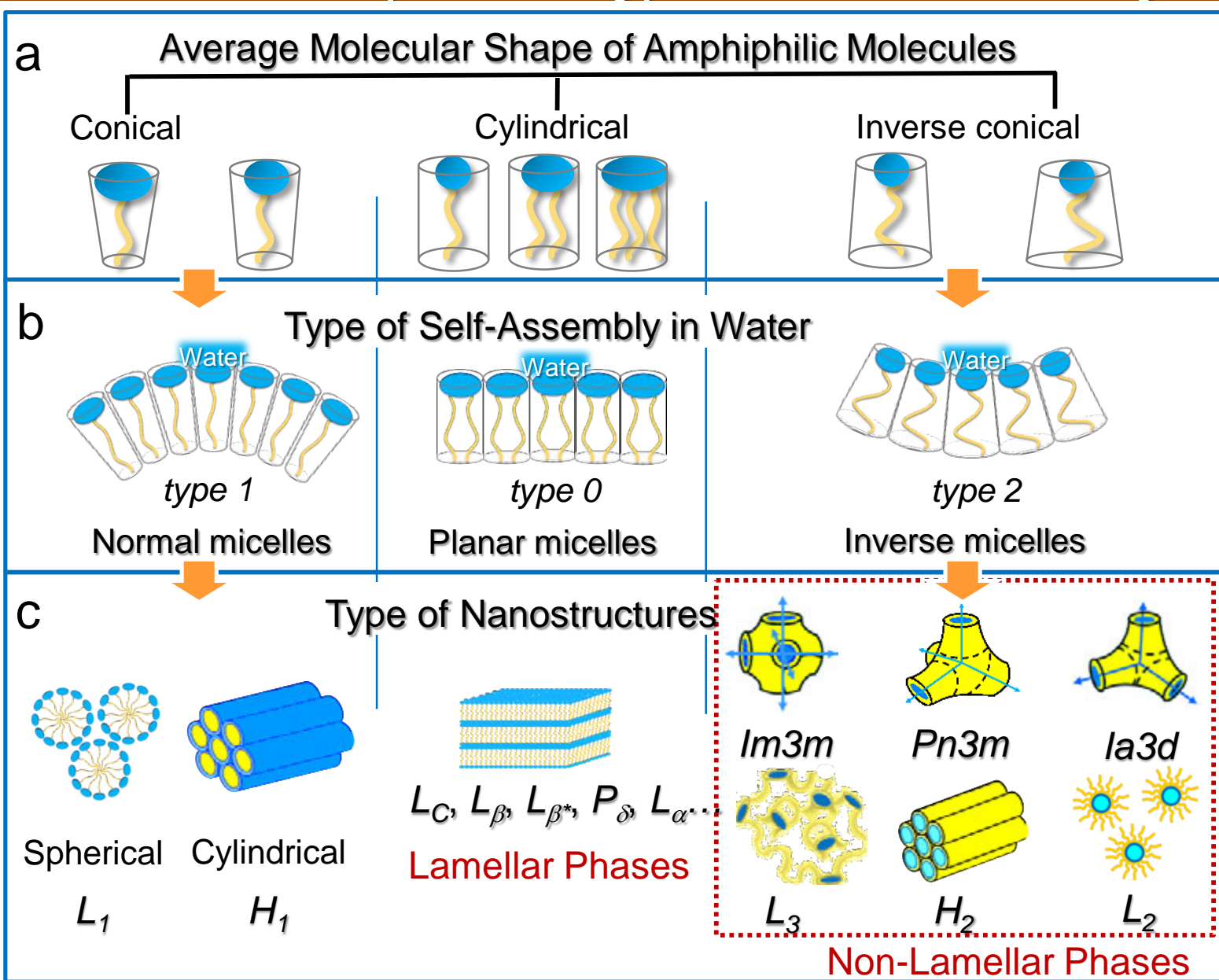
Amphiphilic molecule



Self-Assembly

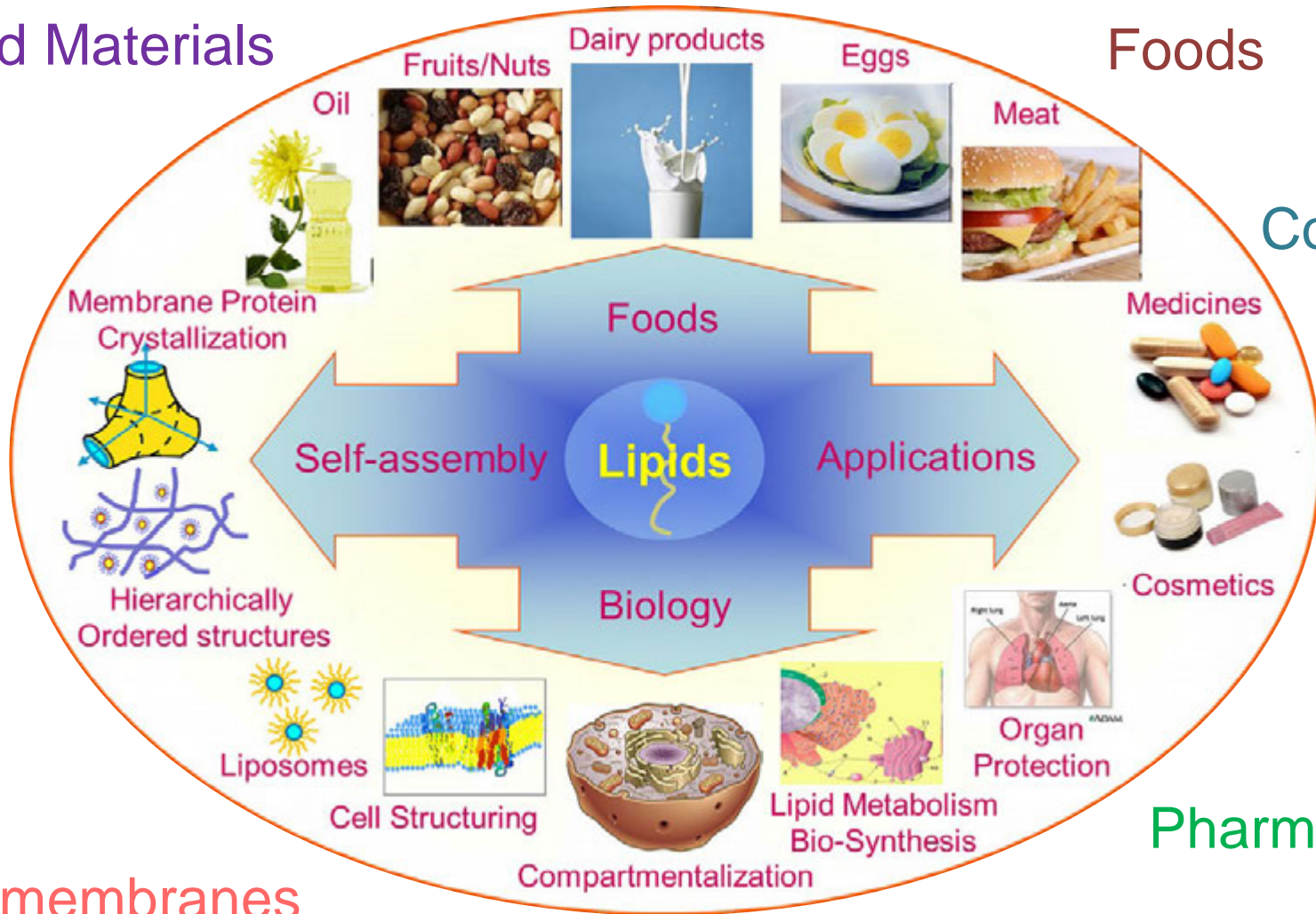
Liposomes/Vesicles

Molecular Shape and Type of Self-Assembly



Lipid Self-assembly in Daily Life

Hybrid Materials



Foods

Cosmetics

Medicines

Cosmetics

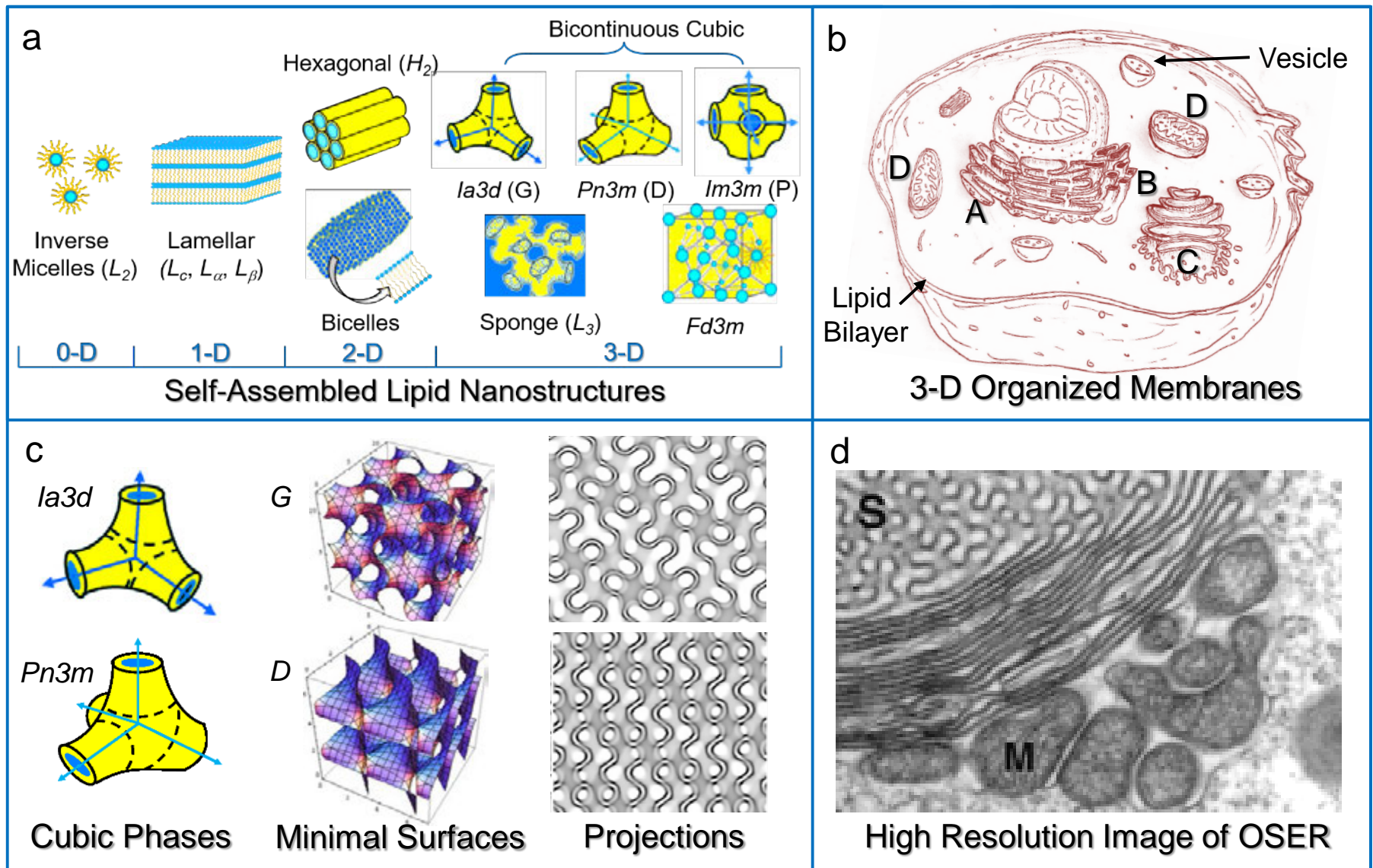
Organ Protection

Pharmaceutics

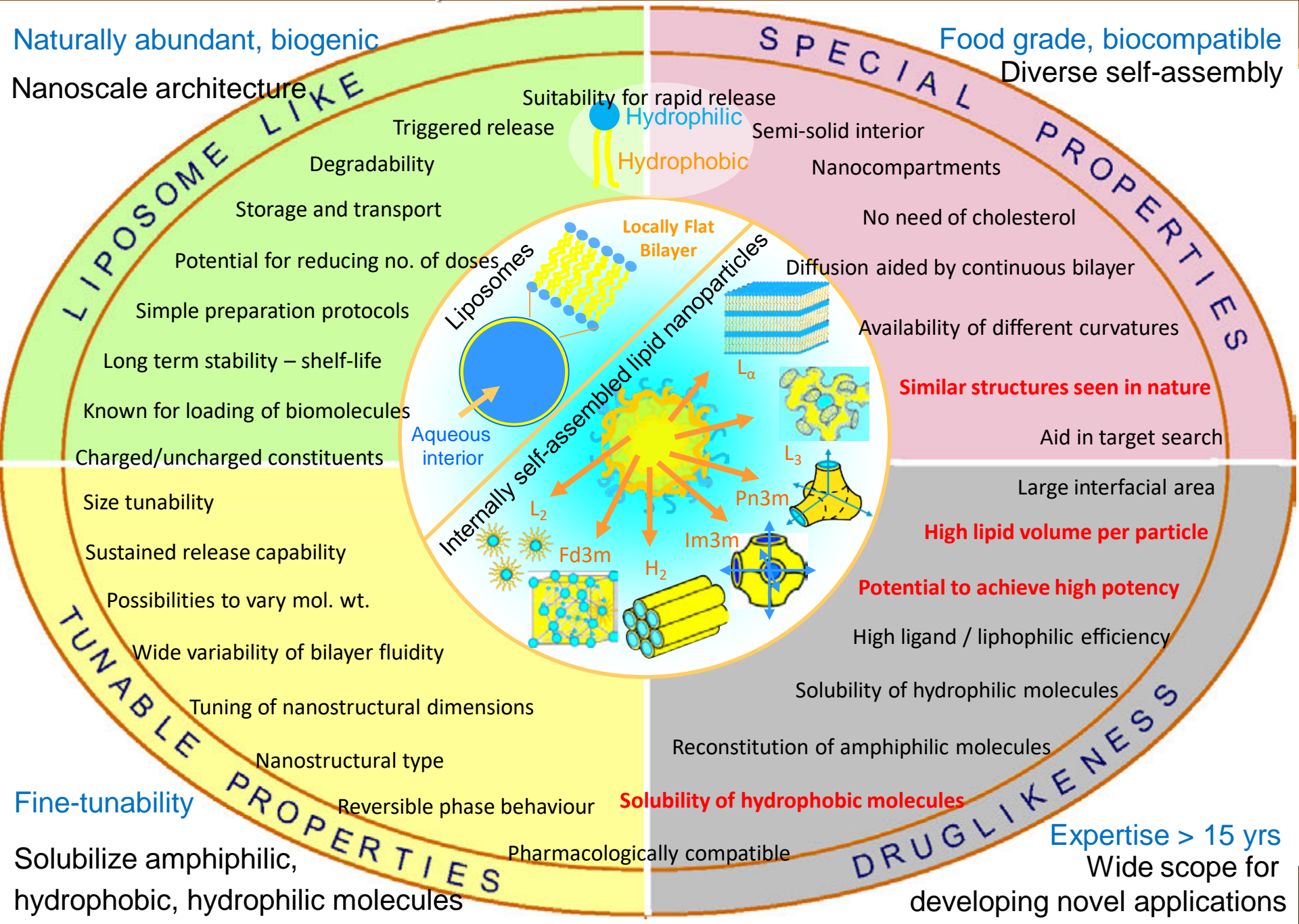
Lipid membranes

Biomedical Applications

Lipid Self-assemblies: Biological Significance



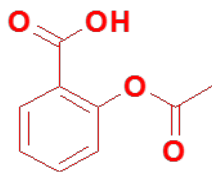
Lipid-Based Nano-carriers



Lipid-Based Formulations: Drug Nano-carriers

Bulk Cubic Phase

Cubosomes



Model drug:
Aspirin

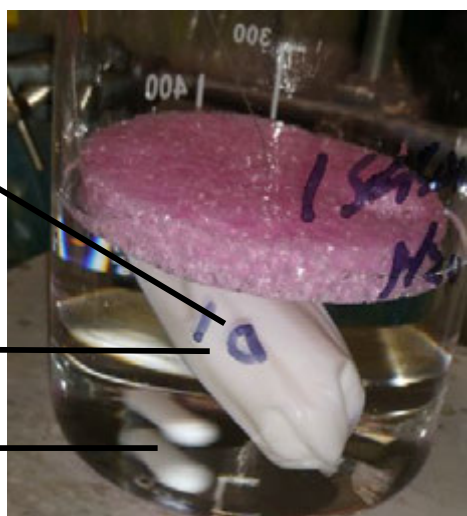
Gel

Fluid

Drug loaded cubosomes

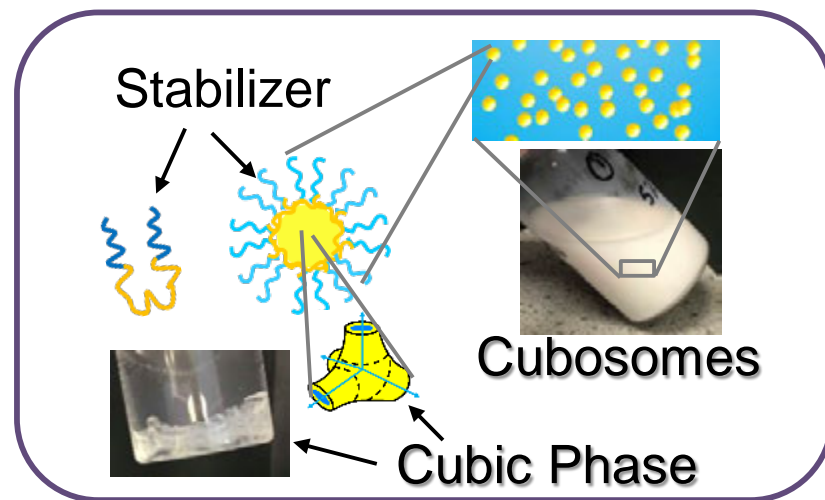
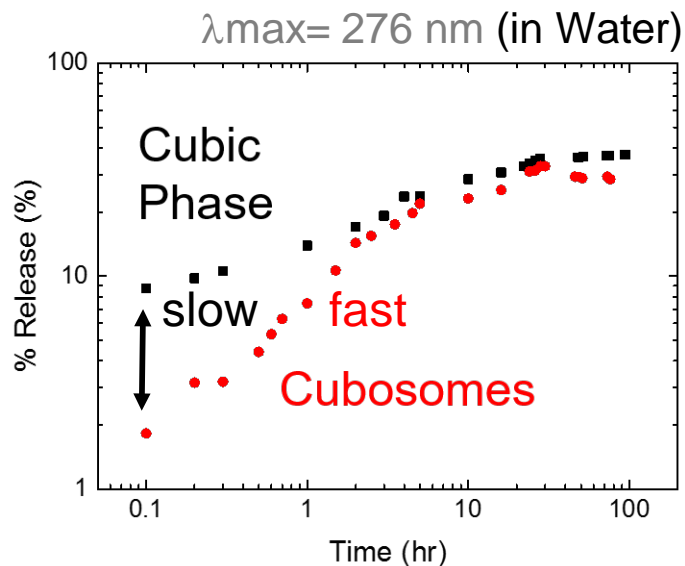
Dialysis membrane

Water/PBS

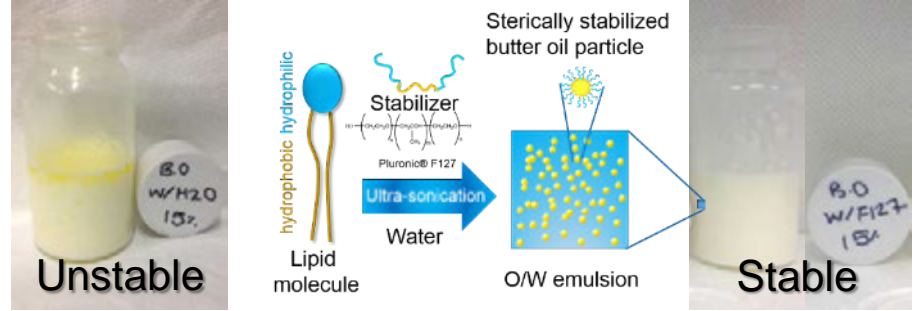
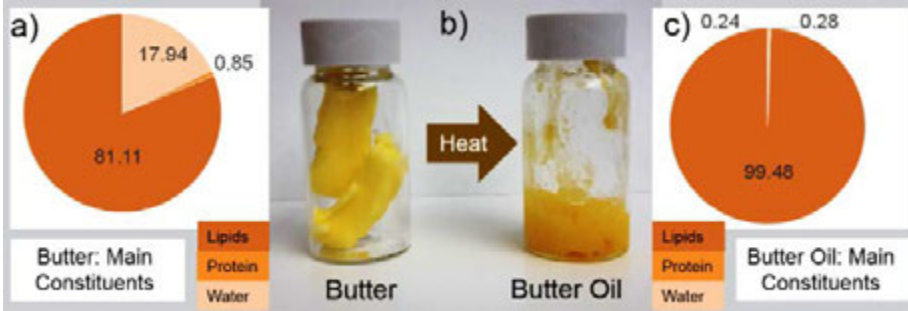


Drug release set-up

Drug Nano-carriers



Lipid-Based Formulations: **Foods and Biles**



Kulkarni, C.V.*(2017) *Journal of Food Processing and Preservation*

Food – Butter and Butter Oil Formulations

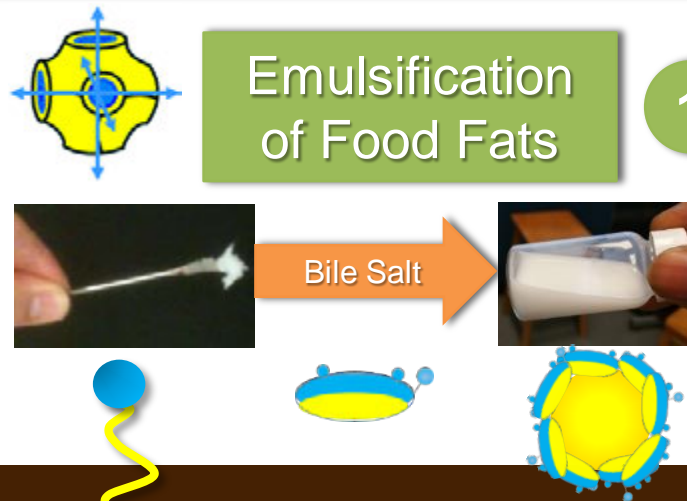
Cheap and abundant source of lipids
Overcome a problem of immiscibility

Food grade itself being food
Retain original hydrophobicity

Display fluid consistency
Stable for several months

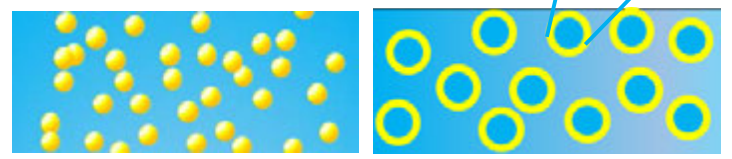
Biles – Lipid + Bile Salts Formulation

Increased surface area for lipase attack

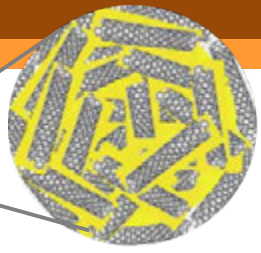
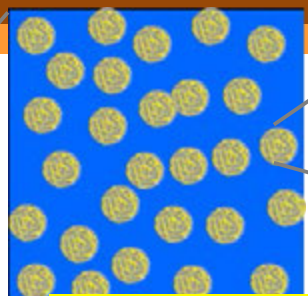


Simple structure ease lipase interaction

2 Conversion into simple structures



Innovative Formulations – Hybrid Nanomaterials



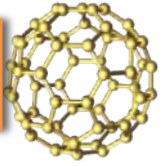
Lipids-Carbon nanotubes

Lipids-Fullerene



Potential advantages: Fullerene C₆₀

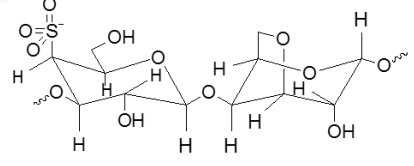
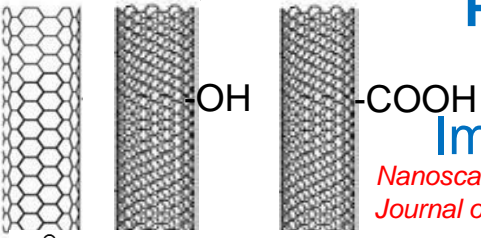
Encapsulation of fullerene in lipid particles



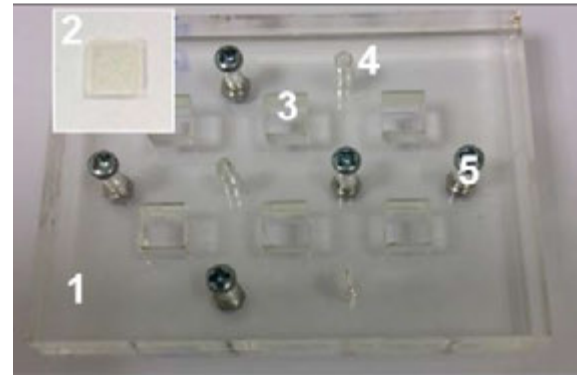
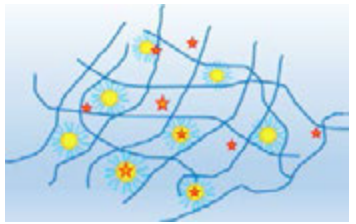
Multidrug loading, Improving biocompatibility

Nanoscale (2015) 7, 1090-1095.
Journal of Visualized Experiments (2016) 108, p. e53489.

Journal of Colloid and Interface Science (2016) 480, 69-75
International J Pharmaceutics (2015) 479, 416-421.

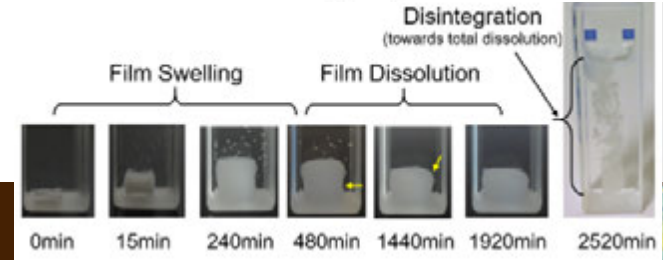
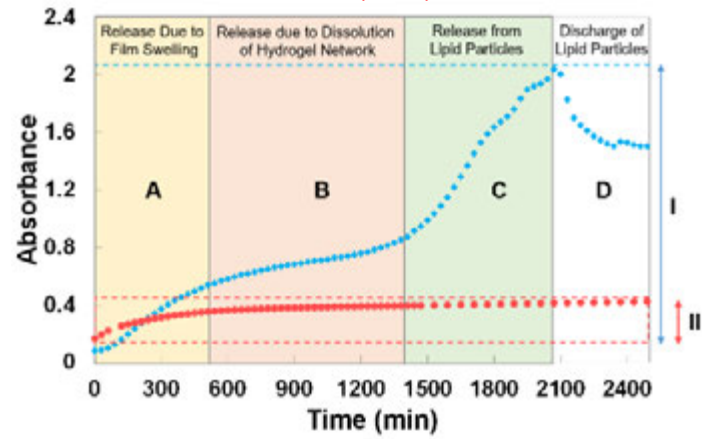


κ-Carrageenan (KC)



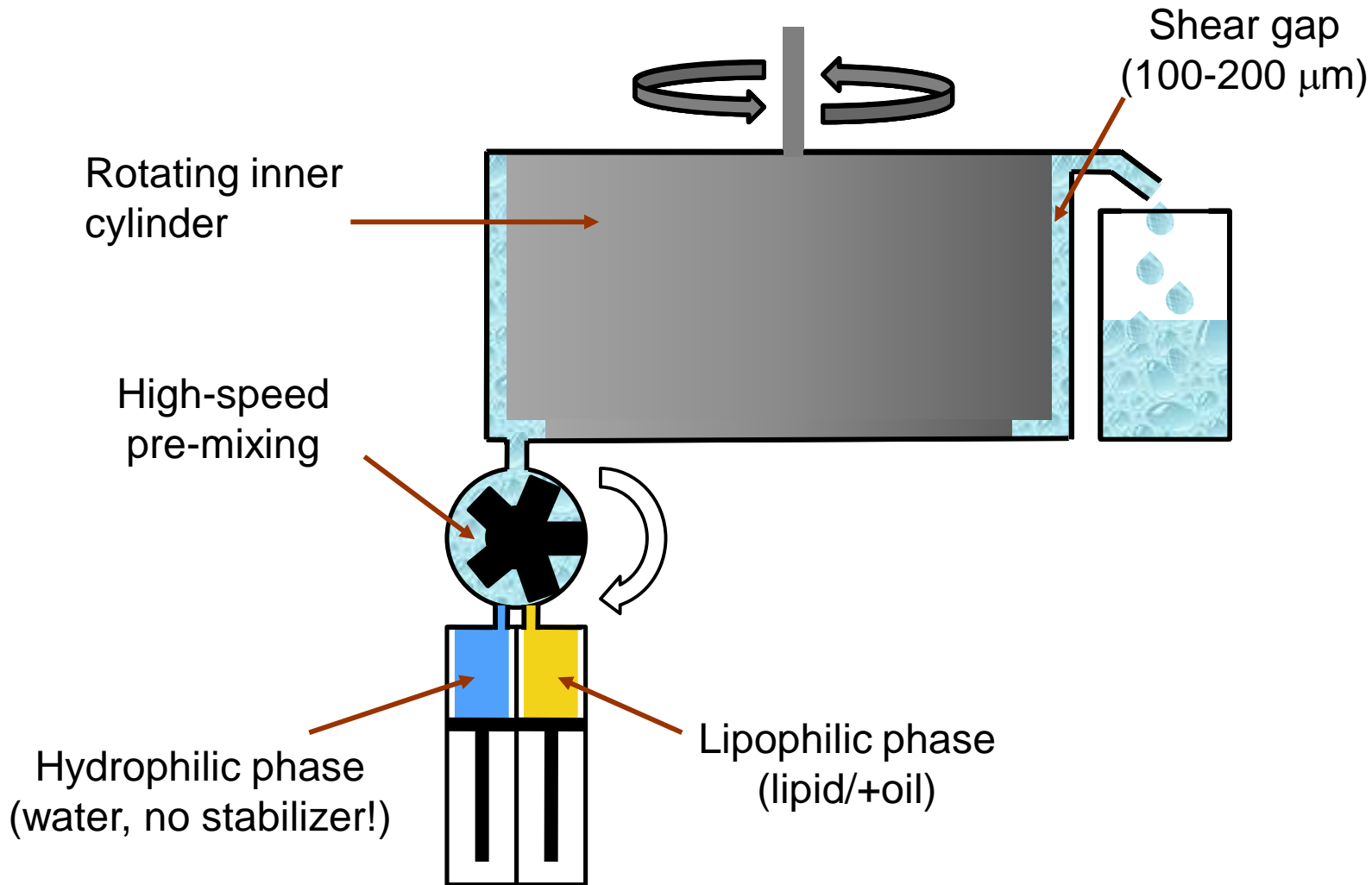
1 mould, 2 ready film, 3 square well, 4 hole for screw, 5 screw

★ Drug Nanostructured lipid particle Self-assembled lipid nanostructure κ-Carrageenan

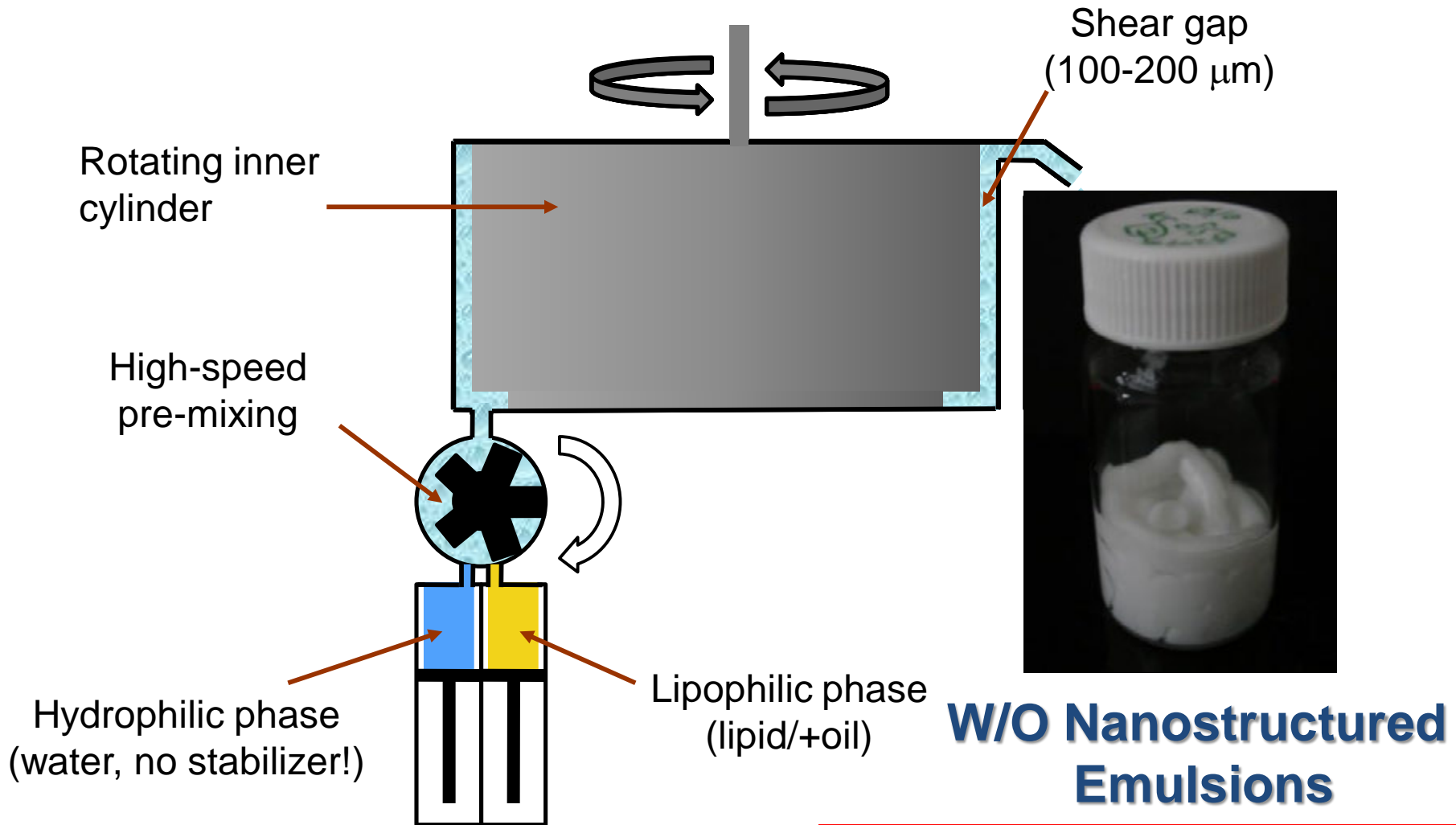


Lipid-hydrogel films for sustained drug release

Cosmetic Formulations: W/O Nanostructured Emulsions

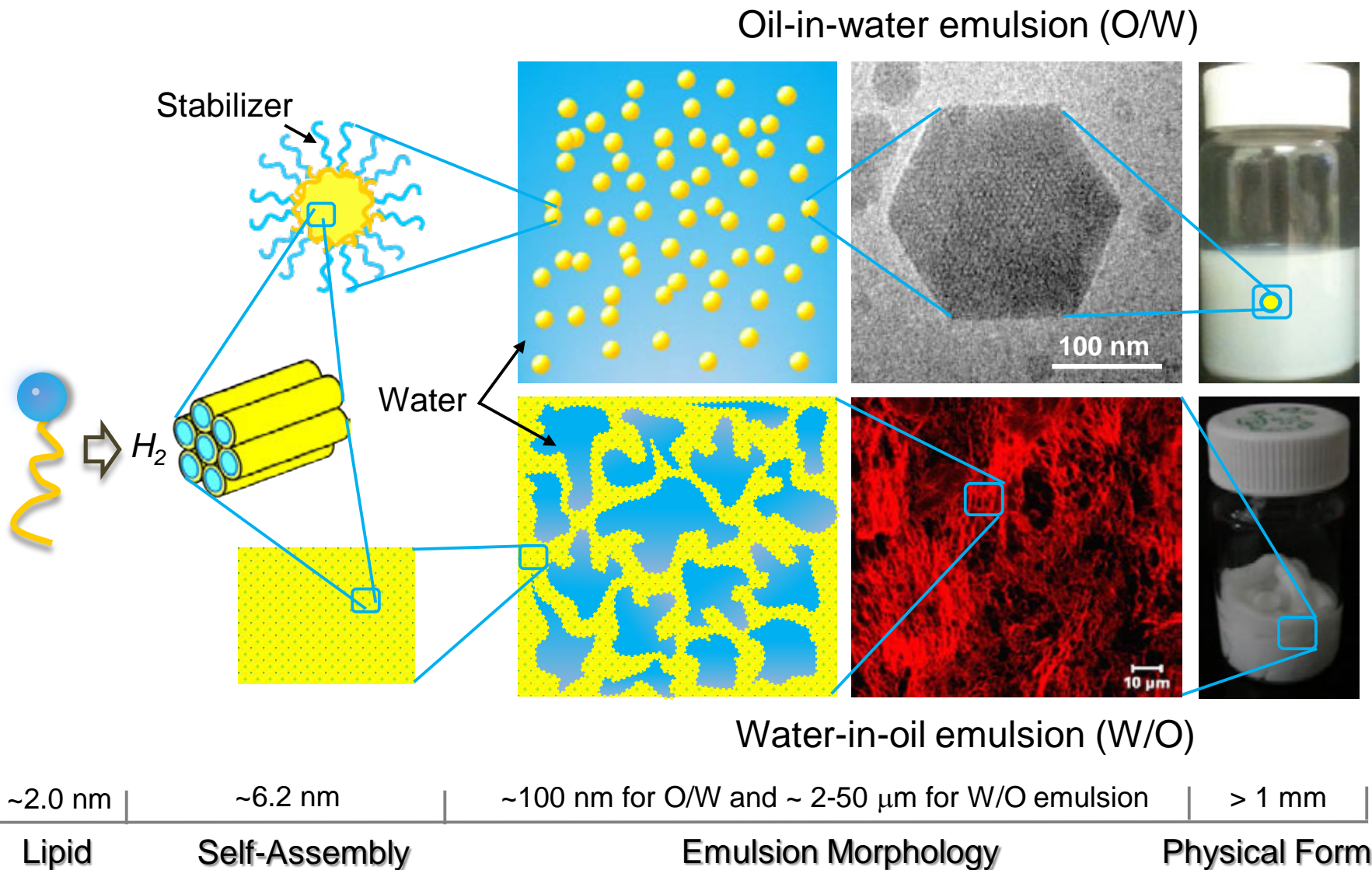


Cosmetic Formulations: W/O Nanostructured Emulsions



Comprised of 50 to 90% of water

Nanostructured Emulsions: W/O and O/W Types



High-Value Formulations: Lipid-Curcumin Systems

Tackling the problem of bioavailability of curcumin



Curcumin formulation in Lipid system- Product Development
[Patent in Final Stages for submission]

The curcumin market growth will increase by \$32.11 million during 2019-2024.

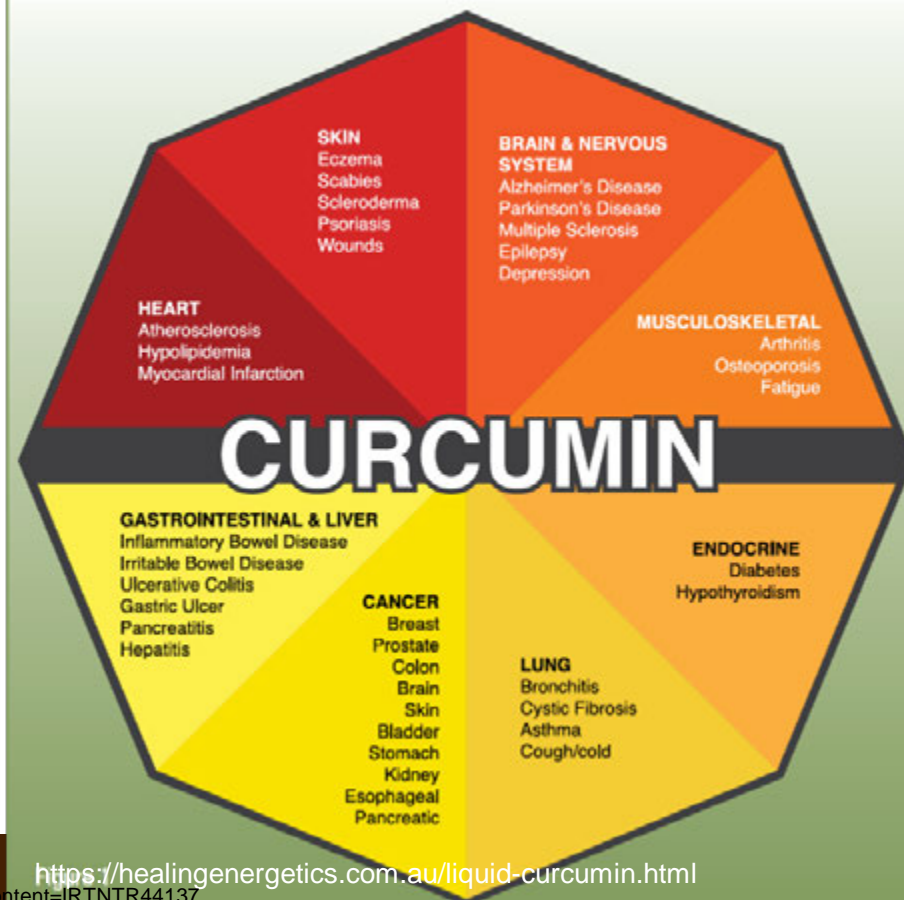
Popular as immune booster:
in Covid-19 era

North America will register the highest growth rate of 31.49% among other regions.

The key factors driving the curcumin market growth are:

- **Therapeutic properties** propelling the demand of curcumin.
- Demand for products that combat the **signs of aging**

THE MANY DISEASES FOR WHICH CURCUMIN IS EFFECTIVE



National/International Collaborations

**Imperial College
London**



**UNIVERSITY OF
CAMBRIDGE**



UNIVERSITY OF LEEDS



**UNIVERSITY of
BRADFORD**

India



Central University of
Technology, Free State

South Africa

**UNIVERSITY OF
COPENHAGEN**



Denmark



United States of America



University of Ljubljana
Faculty of electrical engineering

Slovenia



Austria

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ROYAL SOCIETY
OF CHEMISTRY



RSC INTEREST GROUP
COLLOID AND
INTERFACE SCIENCE



ROYAL SOCIETY OF CHEMISTRY | CHEMISTRY BIOLOGY
INTERFACE DIVISION

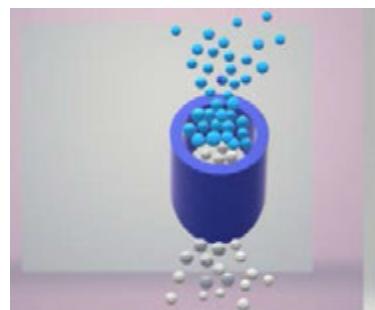
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Research Centre for
Smart Materials



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UNDERGRADUATE RESEARCH INTERNSHIP PROGRAMME

Student Support