Nanocosmetics: A Novel Approach in the Cosmetic and Personal Care Industry

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Introduction to Nanocosmetics

1

Definition

Nanocosmetics are formulations containing nanoscale ingredients, typically 1-100 nanometers in size.

2

Technology

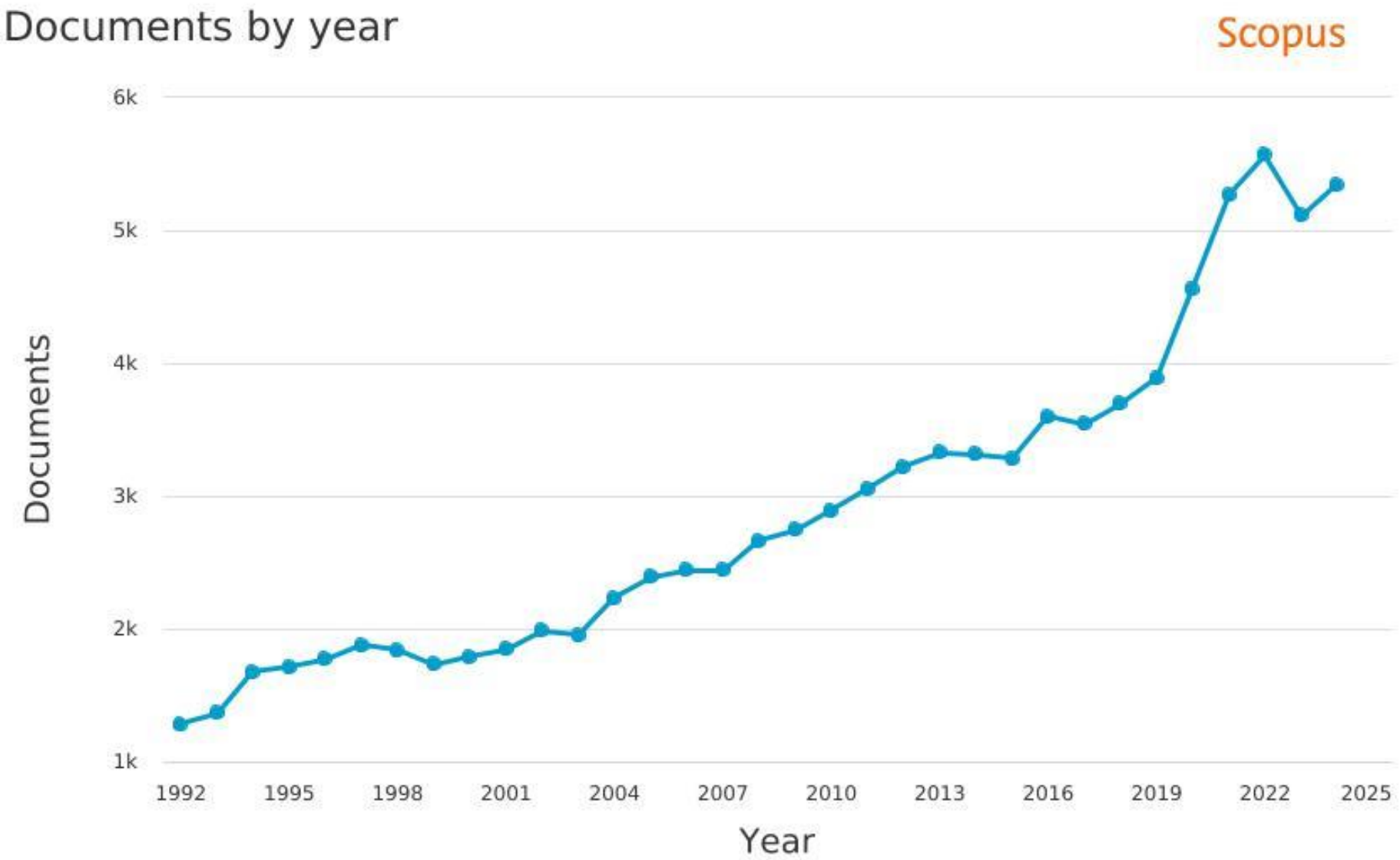
They leverage nanotechnology to enhance penetration, stability, and targeted delivery of active ingredients.

3

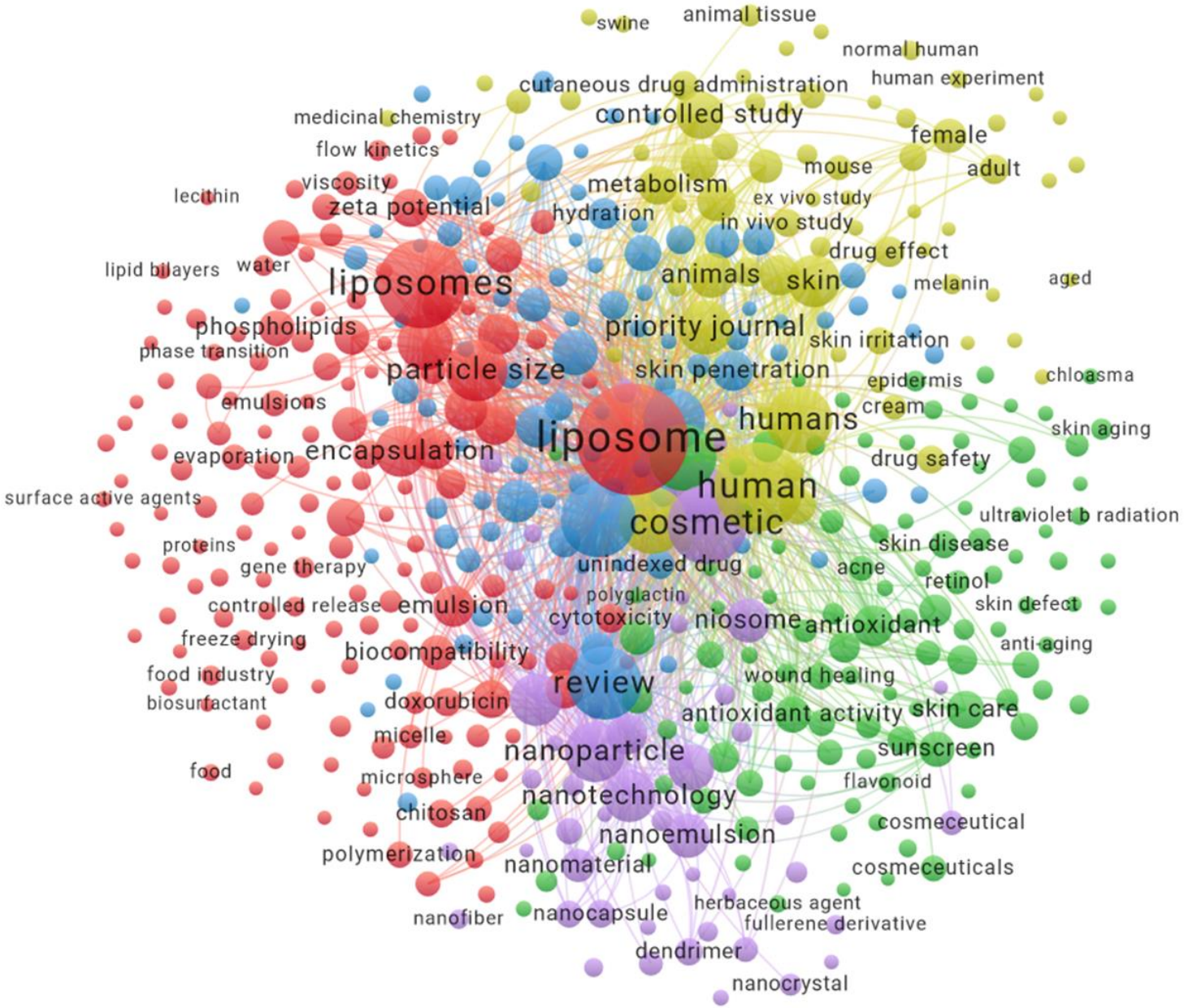
Applications

Nanocosmetics are used in various products, including skincare, haircare, and color cosmetics.

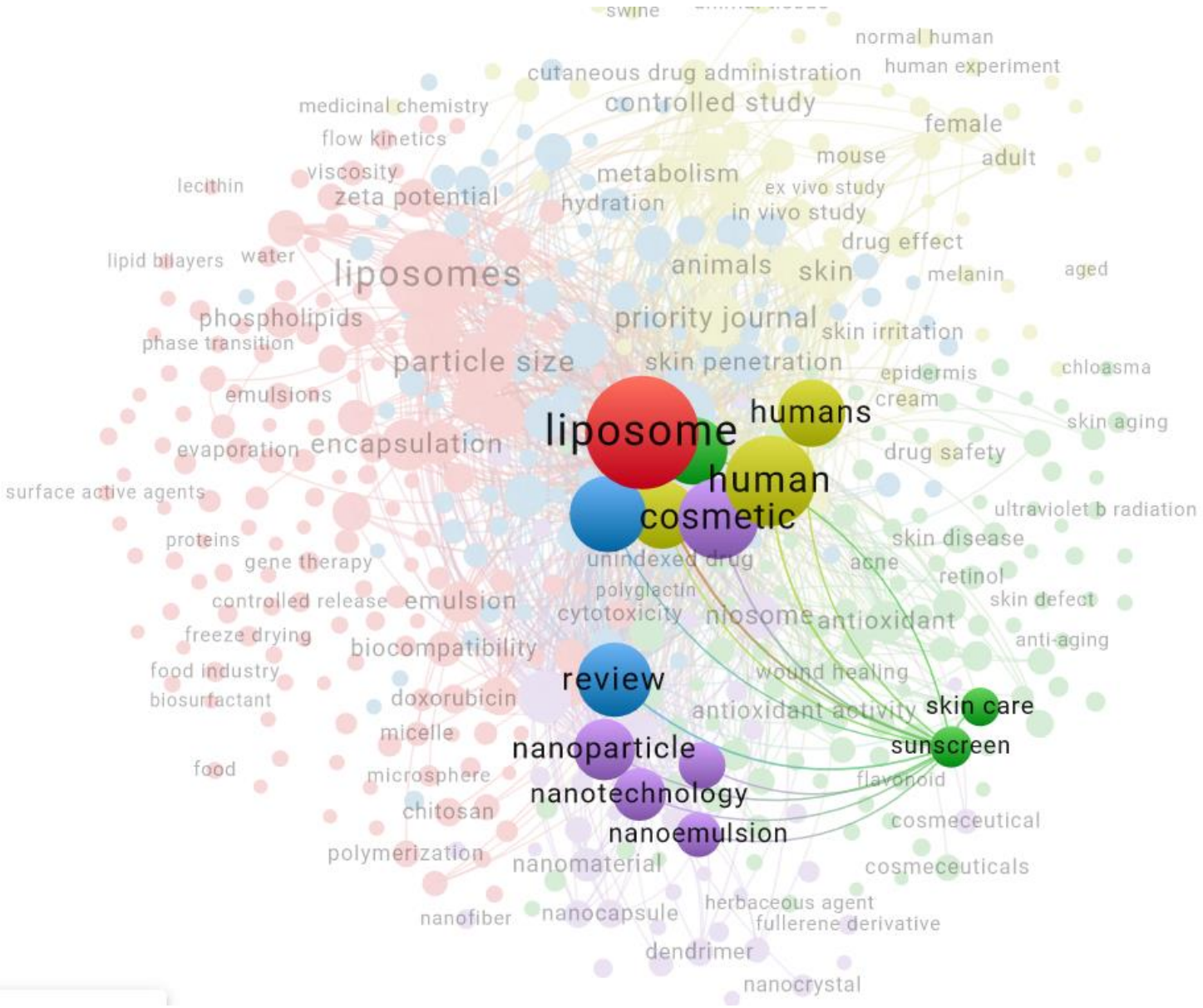
Liposome 109,447 document results



Liposome applications in scientific papers



Liposome applications in scientific papers



تاریخچه لیپوزوم ها

- لیپوزومها بیش از ۷۰ سال است که مورد تحقیقات گسترده قرار گرفته اند.
- امکان حضور ساختارهای وزیکول مانند، در سیستمهای آبی حاوی مولکولهای آمفی پاتیک اولین بار بوسیله Bernard در سال ۱۹۴۷ فرض گردید.

در سال ۱۹۶۲، A.D.Bangham و R.W.Home با استفاده از میکروسکوپ الکترونی، پراکندگی فسفولیپیدها را در آب بررسی کردند. نتایج کلی آزمایشات نشان می داد که فسفولیپید به طریق خود مونتاژی (self-assemble) ساختار کیف مانندی را تشکیل می دهد که Gerald Weissman آنها را لیپوزوم نامید.

مشخصات لیپوزوم ها

لیپوزوم وزیکولی میکروسکوپی شامل دولایه‌ی فسفولیپیدی است که یک فضای مائی را احاطه می کند.

ضخامت لیپید دولایه بطور معمول بین ۳ تا ۶ نانومتر می باشد.

لیپوزومهای تشکیل شده قطری بین ۵۰ نانومتر تا ۵۰ میکرومتر دارند.

لیپوزوم ها به دلیل خصوصیات آمفیپاتیکی (دوگانه دوستی) عناصر سازنده آنها، امکان دارورسانی داروهای هیدروفیل و لیپوفیل را فراهم می نمایند.

لیپوزوم ها به عنوان یک حامل بسیار مناسب درسیستم های دارورسانی نوین مورد توجه واقع شده اند، چون :

سمیت ذاتی پایین دارند، زیست تجزیه پذیرند، ایمونوژنیسیته نیستند، ساختارهای ریز و کیسه مانندی دارند (شبیه بسته یا کپسول)

با به دام انداختن دارو درون لیپوزوم (انکپسولاسیون)، از آن برای حمل داروها به نقاط مختلف بدن استفاده می شود.

Lecithin Characterization

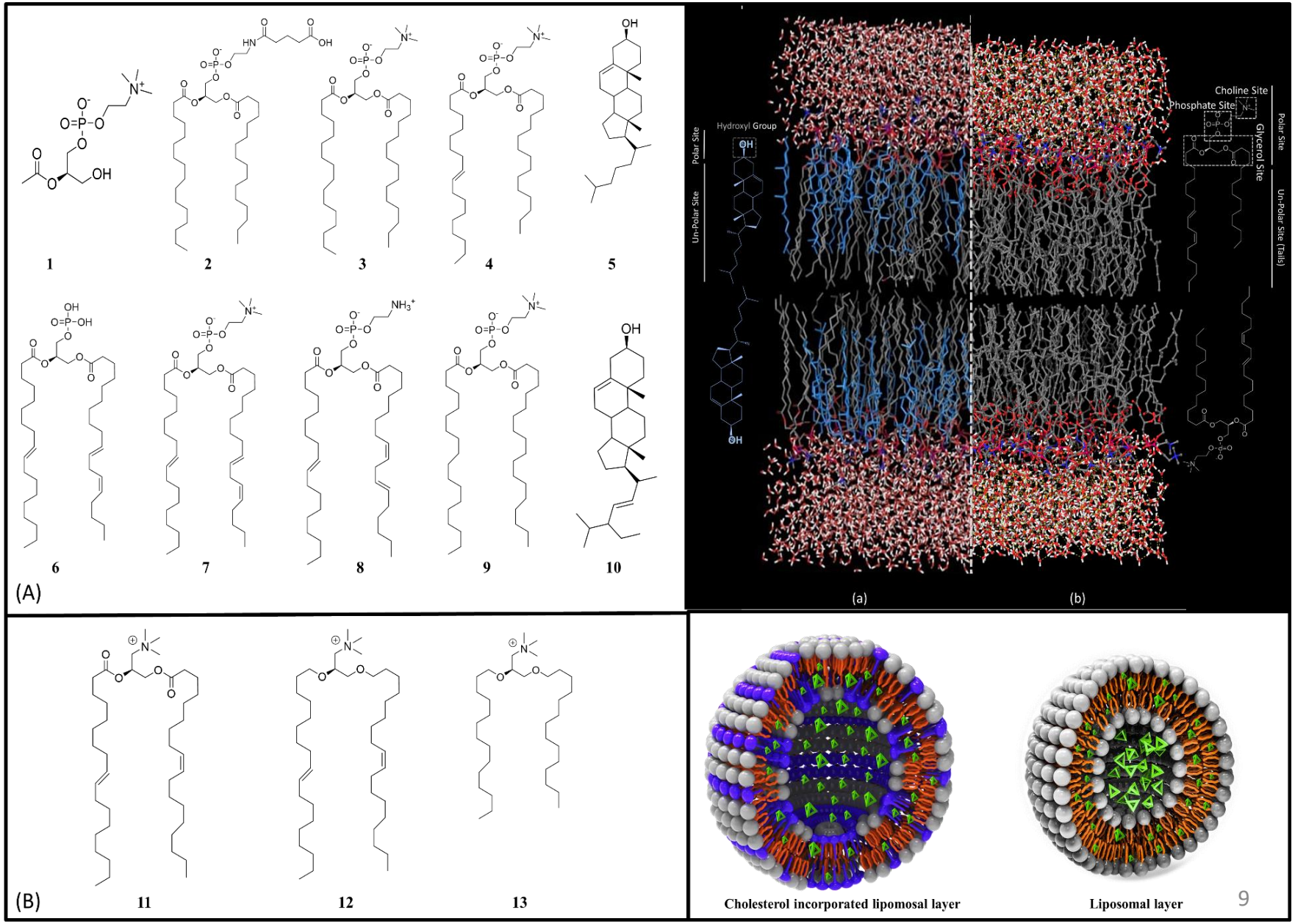
- Lecithin (mixture of phospholipids)
  - Natural: egg yolk, Soy bean, Sunflower oil
  - Synthetic
- Cholesterol
- Alpha- tocopherol

No.	Analysis test
1	Phosphatidylcholine assay (%) (45-96%)
2	Loss on drying (%)
3	Acid value (mg KOH/g)
4	Peroxide value (meq/g)
5	Arsenic (less than 1 ppm)
6	Heavy metals (less than 10 ppm)
7	Phase transition temperature

- At various temperature, phospholipid membranes can exist in different phase.
- The transition from one phase to another can be detected by deferent techniques

Bilayer interaction simulation based on molecular docking study

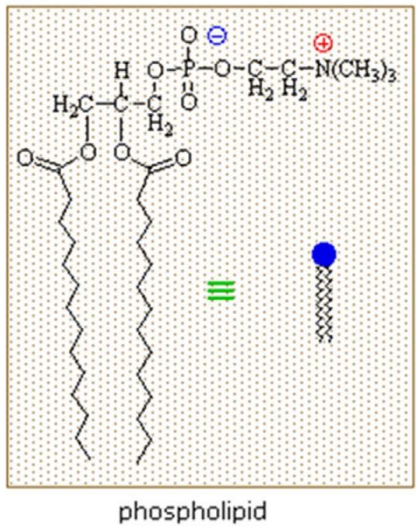
Different natural and synthesized lipid carriers and their molecular orientation in liposomal bilayer

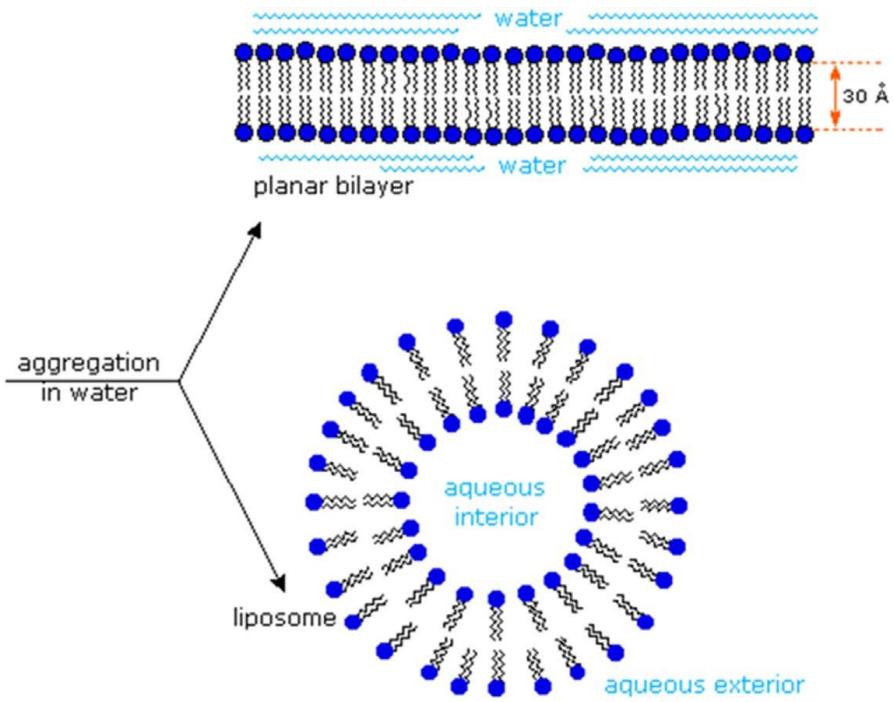


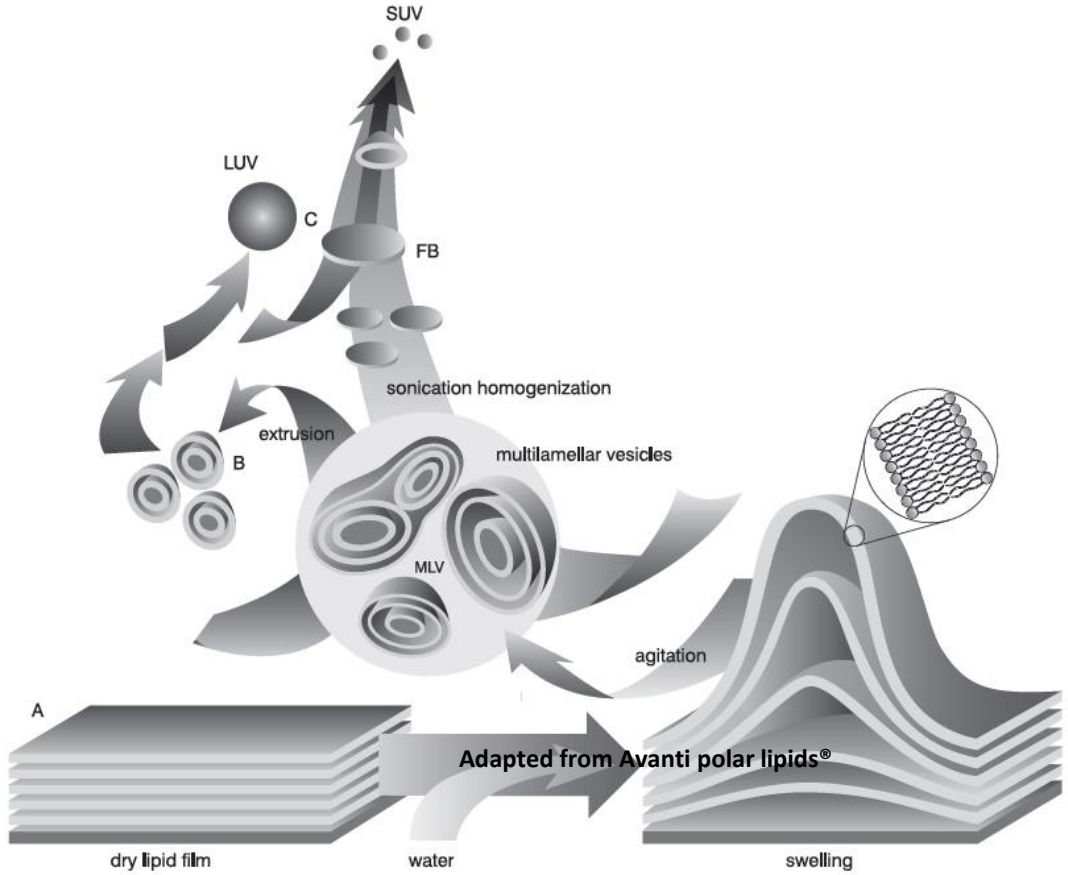
Nanoliposomes

Nanoliposomes are nanoscale vesicles composed of lipid bilayers, typically used for encapsulating active compounds, such as pharmaceuticals, nutraceuticals, or other bioactive molecules.

Synthetic vesicle consisting of one or more lipid bilayers that form both hydrophobic and hydrophilic compartments.

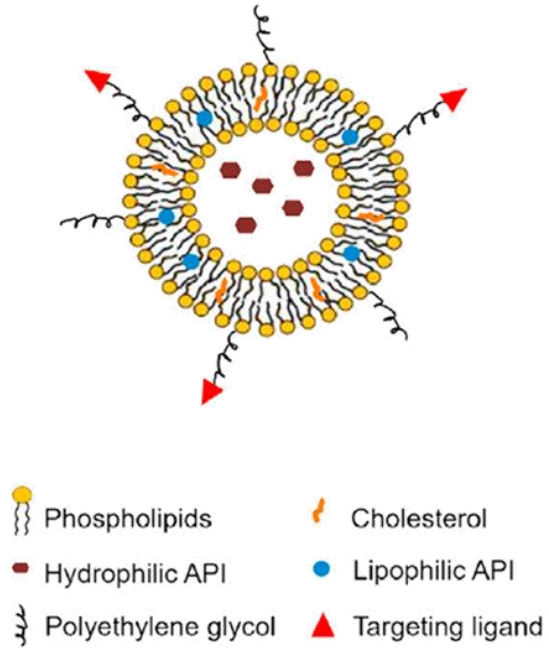


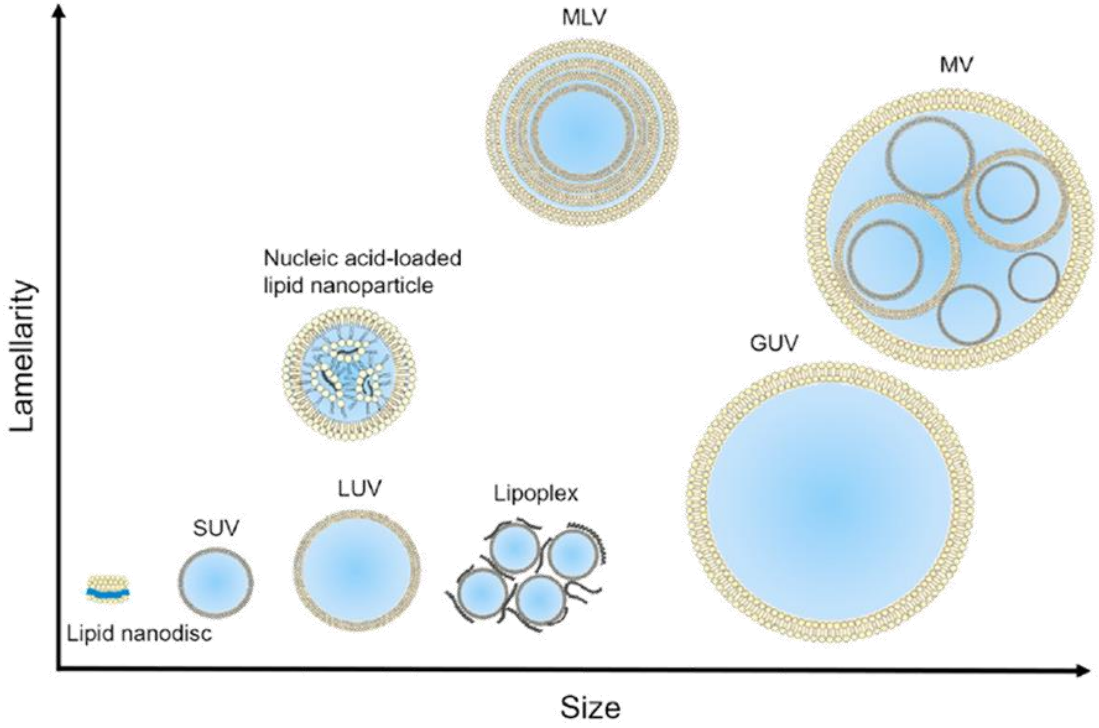




Nanda, A., et al (2020). *Nanocosmetics: fundamentals, applications and toxicity*.

Structure and classification of lipid-based drug delivery systems





Structural illustration of liposome formulations. Phospholipids and cholesterol self-assemble into a lipid bilayer surrounding an aqueous core, allowing for encapsulation of lipophilic drugs in the lipid layer and hydrophilic drugs in the core. Liposomes can be modified on their surfaces with polyethylene glycol and targeting ligands.

Classification of lipid-based drug delivery systems according to their particle size and lamellarity. SUV, small unilamellar vesicle; LUV, large unilamellar vesicle; GUV, giant unilamellarvesicle; MLV, multilamellar vesicle; MV, multivesicular vesicle. Nanodisc is shown with wrapped lipoprotein; lipoplex and nucleic acid-loaded nanoparticle are shown with complexed nucleic acids.

Fan Y, Marioli M, Zhang K. J. Pharmaceutical And Biomedical Analysis. 2021;192:113642.

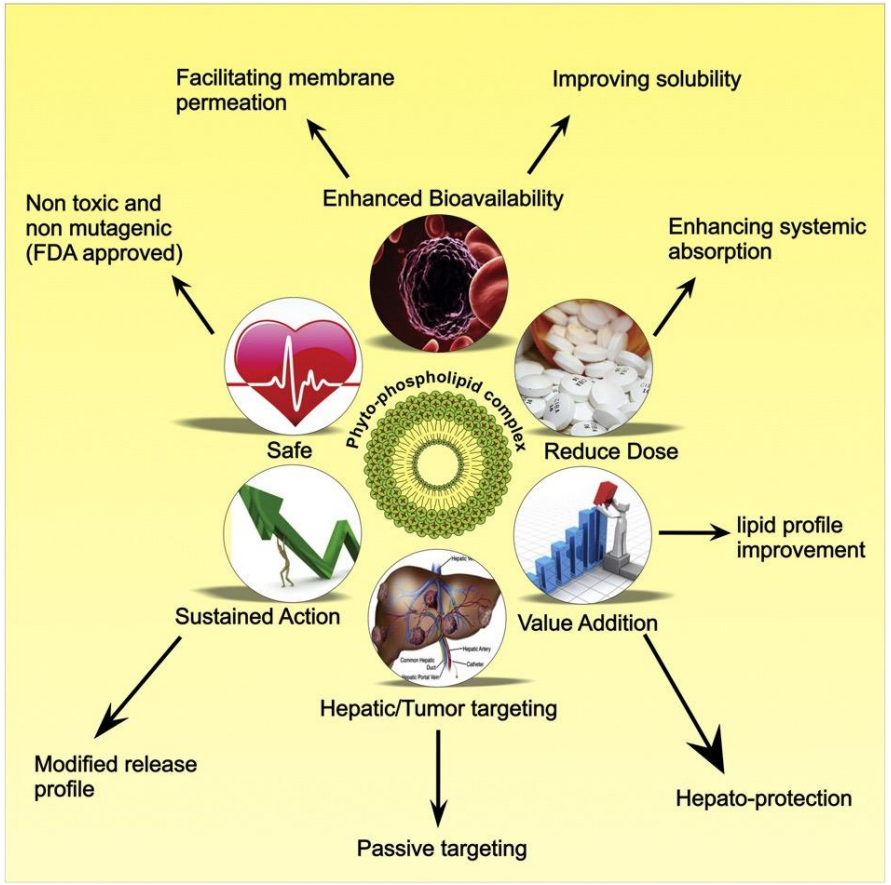
Justification

Pharmaceuticals: Nanoliposomes reduce drug dosages and side effects, lowering healthcare costs and improving patient compliance.

Nutraceuticals and Food: They enhance bioavailability, optimizing production costs while improving efficacy and consumer satisfaction.

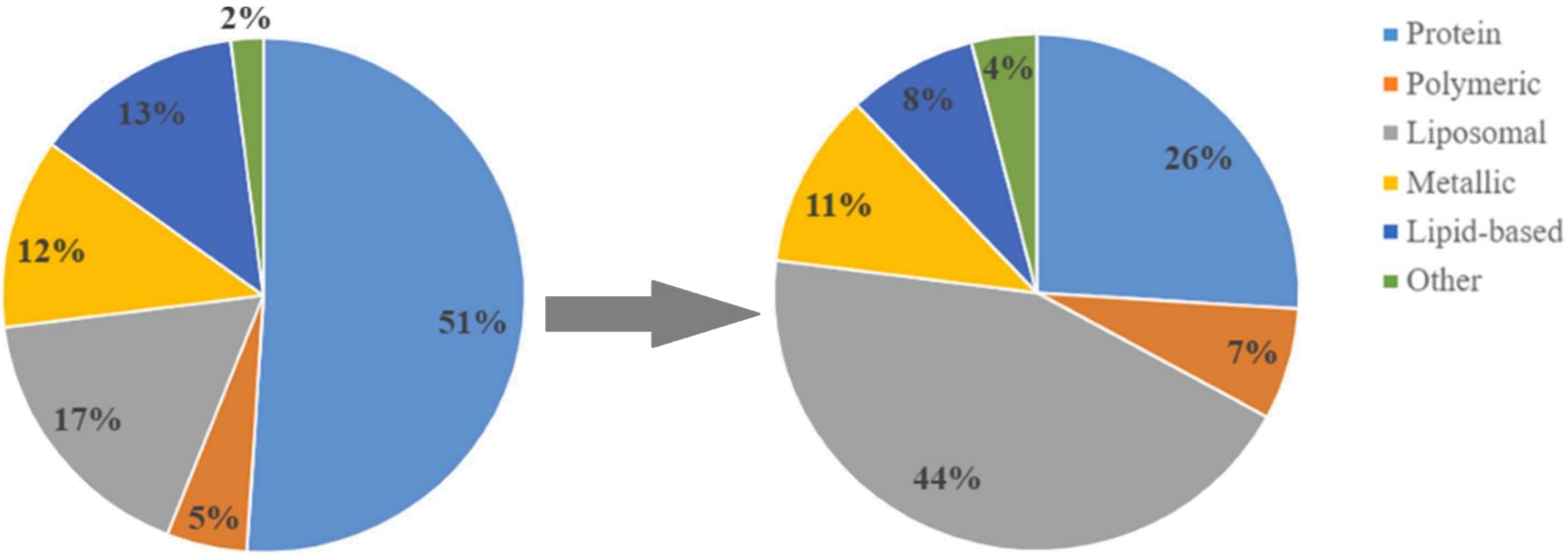
Cosmetics: Improved ingredient delivery and extended shelf-life reduce waste and lower production costs, increasing profitability.

Agriculture: Controlled release of chemicals minimizes usage and environmental impact, leading to cost savings and higher crop yields.



Khan J, Alexander A, Saraf S, Saraf S. 2013;168(1):50-60.

Types of nanoparticles in clinical trials



2002 to 2016 **2016 to 2021**

The pie charts highlight the growing role of liposomal drugs (in gray) in nanomedicine.

Giordani, S., et al (2023). *Journal of Pharmaceutical and Biomedical Analysis*, p.115751.

Advantages of Nanocosmetics

1 **Enhanced Absorption**

Nanoparticles penetrate deeper into the skin, increasing the efficacy of active ingredients.

2 **Improved Stability**

Nanotechnology enhances product shelf life and protects sensitive ingredients from degradation.

3 **Targeted Delivery**

Nanocarriers can deliver active ingredients to specific skin layers or hair follicles.

Formulation and Manufacturing Considerations

1 — Material Selection

Careful choice of nanomaterials based on desired properties and safety profiles.

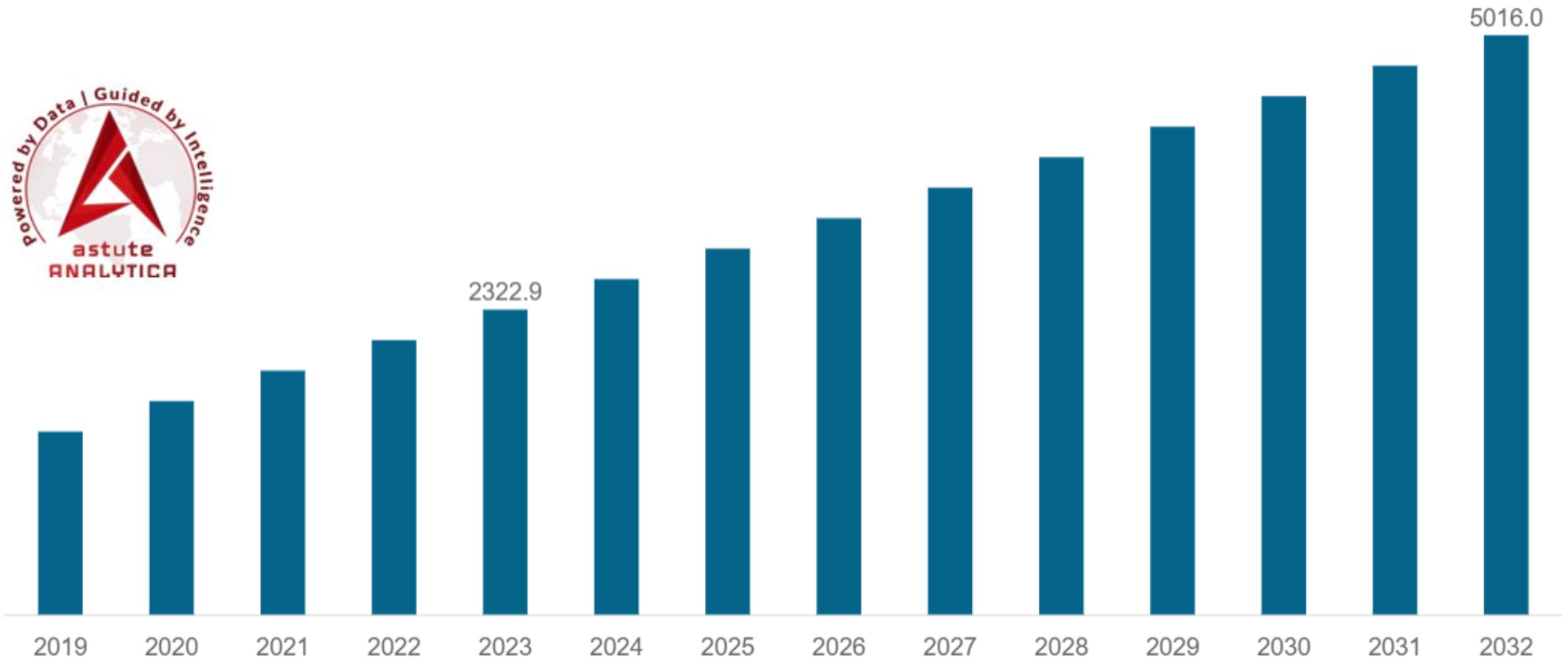
2 — Particle Engineering

Precise control of nanoparticle size, shape, and surface properties during synthesis.

3 — Stability Testing

Rigorous testing to ensure nanoformulations remain stable throughout shelf life.

Global Liposome Development Service Market Size, 2019-2032 (USD Million)

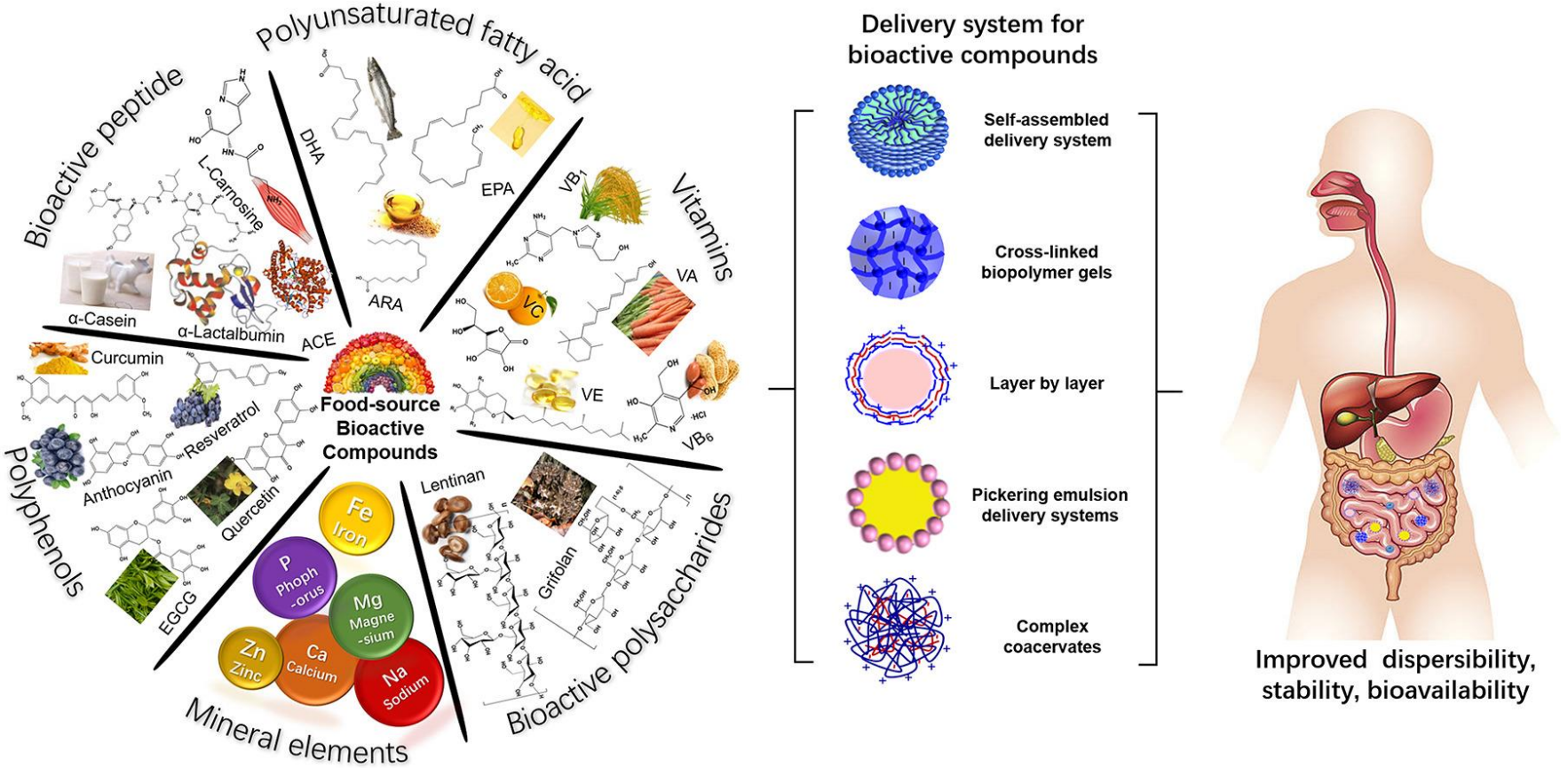


https://www.astuteanalytica.com/industry-report/liposome-development-service-market

Why We Choose Encapsulation Technique?

- **Encapsulation is one of the core concepts in object-oriented programming, general.**
- **Micro/Nano Encapsulation:**

Defined as a process in which tiny particles or droplets of the active ingredient(s) are surrounded by a coating or embedded in a homogeneous or heterogeneous matrix in form of solution, suspension and powder.



Food Research International, 120, 2019, 130-140

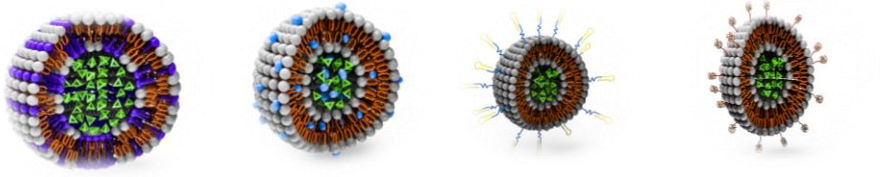
A New Approach on Target Delivery: A Review on two Decade Micro/Nano-Liposome/Phytosome Modification

Lipid-based nano-carriers

- Solid Lipid Nanoparticle (SLN)
- Nanostructure Lipid Carriers (NLC)
- **Liposome**
- Nanoemulsion/Nanosuspension
- Lipid Nanotubes

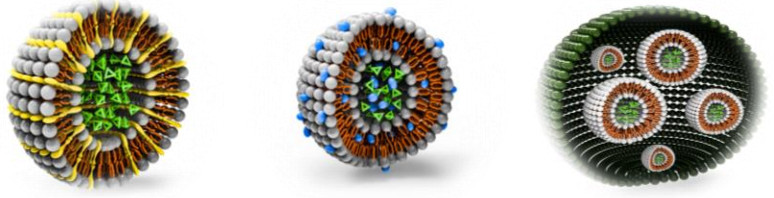
Thirty different liposome surface modifications

Surface Modification (Improve physiochemical properties)



Niosome | Ethosome | Transfersome | Polymer Coating

Labeling



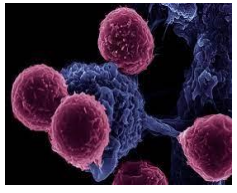
Corona Protein-Liposome | Aptamosome | Virosome/Enzymosome

Liposome Functionality

Inhalation

Brain disorders

Anti-obesity



Gastrointestinal

Infection

Vaccination and Immunology

→ **Food and Cosmetic**

What is an Industrial Consequence of these Technique?

❑ Liposome in Skin Product:

Indena company, a pioneer on phytosome technology recently called phytosome *Absolute carrier*. Their product is the initial product of different food and Pharmaceutics companies.

SILIPHOS® GREENSELECT® MERIVA® CASPEROME® QUERCEFIT™ VAZGUARD™ UBIQSOME®

Anti aging cream (Phytosome Ginseng).

ß-Sitosterol Phytosome® (Indena) is a microencapsulation and orange peel skin condition improver. It is suitable for body, legs, and foot care products, anti-cellulite products, to reduce eye puffiness, and for medical devices.

❑ Liposome in Food Product:

Food Supplement (In form of nanoemulsion, solution and suspension)
Resveratrol, Curcumin, Vitamin C, Coenzyme Q10.

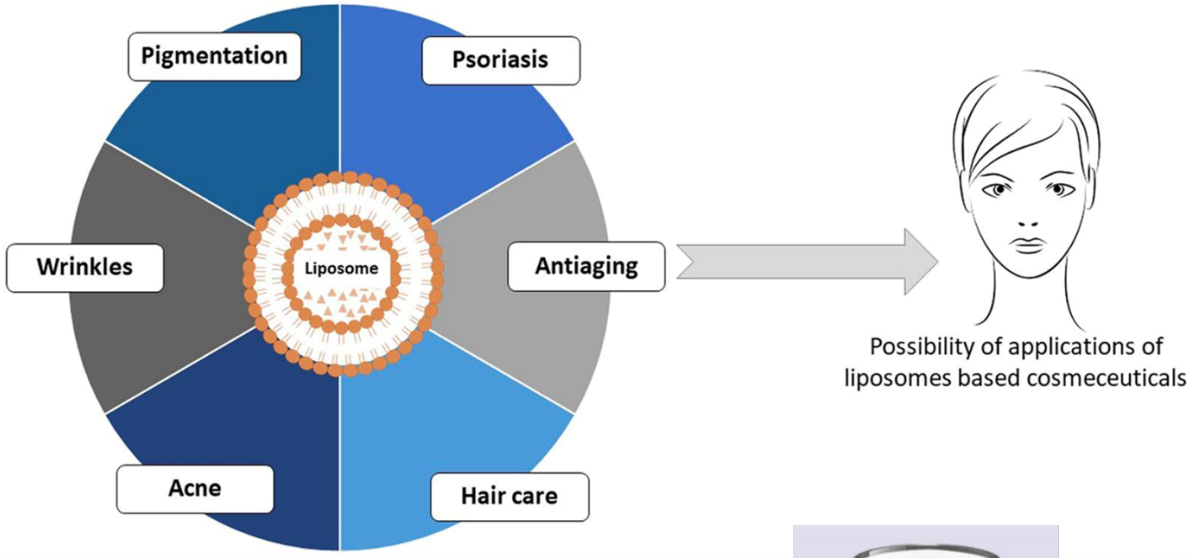
Phytosome were used in majority of their product from food supplement to flavour, etc.

Food nutrient supplement.

http://www.lifeosome.com/?page_id=6640
https://www.actinovo.com/

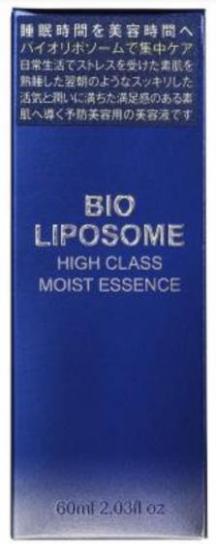
https://www.indena.com/products/nutraceuticals/#
https://futureyouhealthhk.com/

Nanoliposomes applications in cosmetics



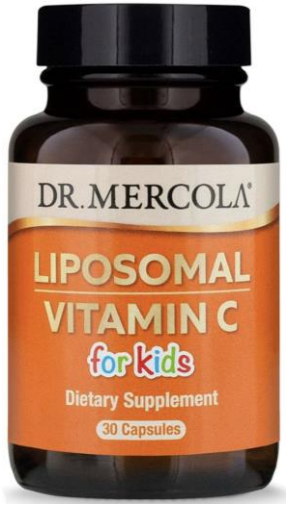
Liposomal antioxidant and anti-aging cream

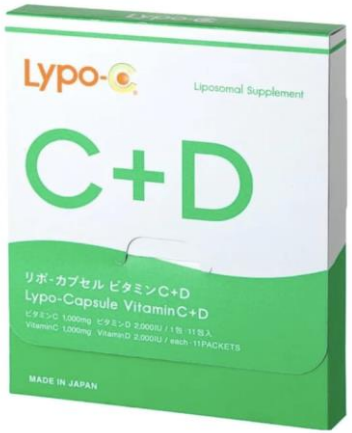
Japanese Placen Liposomal 100% Concentrated Serum, EGF, FGF, HUMANANO", Paraben Free, Alcohol Free, Mineral Oil Free, Cruelty Free



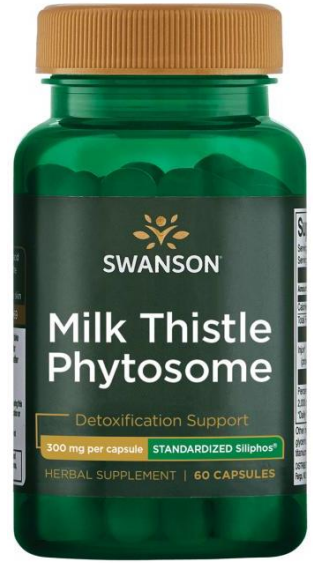
BIO LIPOSOME High Class Moist Essence Anti-aging Serum With Bioliposomes For Morning Care

Nanoliposomes applications in supplements

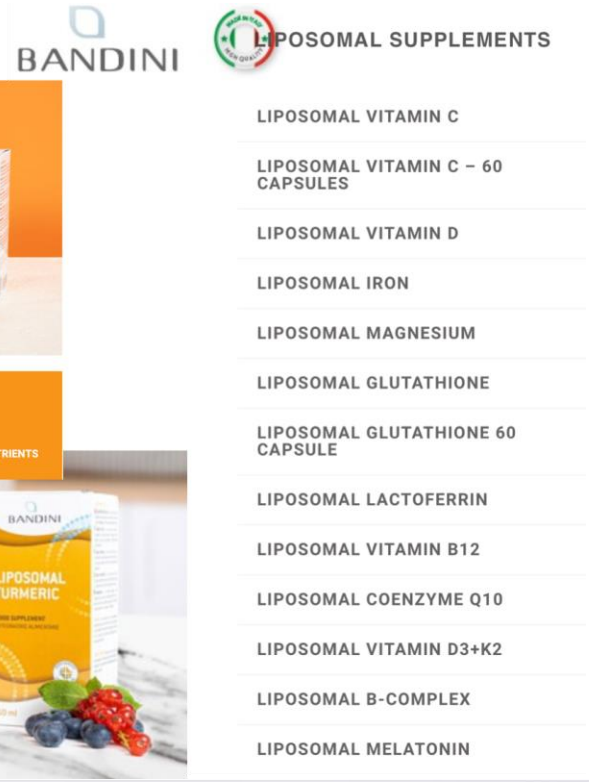


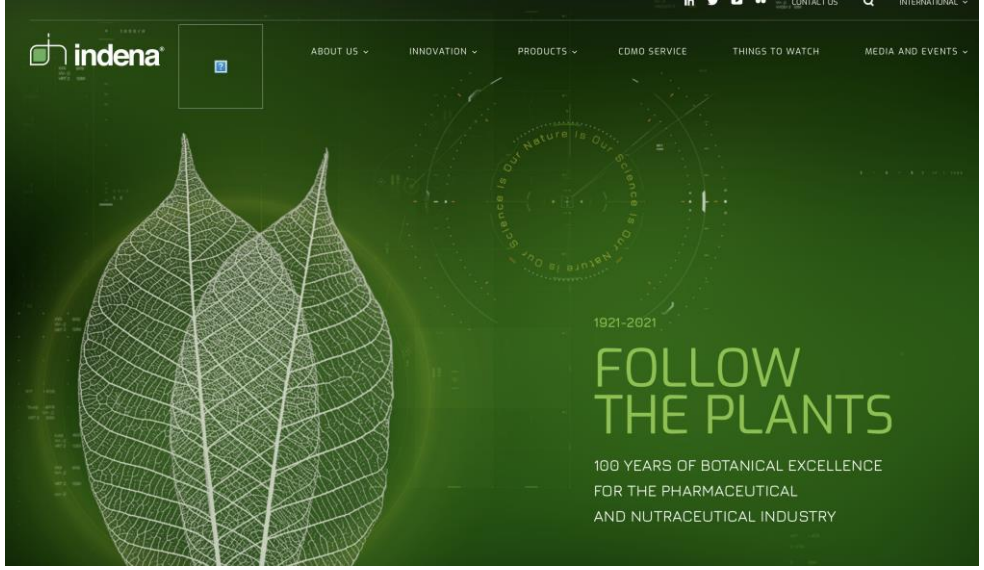


Lipocapsule Vitamin C+D3 Capsules Liposome




LIPOSOMAL TECHNOLOGY, WHY SHOULD WE USE IT?
BANDINI
LIPOSOMAL VITAMIN C
LIPOSOMAL VITAMIN B12
LIPOSOMAL LACTOFERRIN
x 46
LIPOSOMES IMPROVE THE BIOAVAILABILITY OF NUTRIENTS 46 TIMES
LIPOSOMAL GLUTATHIONE
LIPOSOMAL MAGNESIUM
LIPOSOMAL VITAMIN C
LIPOSOMAL TURMERIC


BANDINI
LIPOSOMAL SUPPLEMENTS
LIPOSOMAL VITAMIN C
LIPOSOMAL VITAMIN C – 60 CAPSULES
LIPOSOMAL VITAMIN D
LIPOSOMAL IRON
LIPOSOMAL MAGNESIUM
LIPOSOMAL GLUTATHIONE
LIPOSOMAL GLUTATHIONE 60 CAPSULE
LIPOSOMAL LACTOFERRIN
LIPOSOMAL VITAMIN B12
LIPOSOMAL COENZYME Q10
LIPOSOMAL VITAMIN D3+K2
LIPOSOMAL B-COMPLEX
LIPOSOMAL MELATONIN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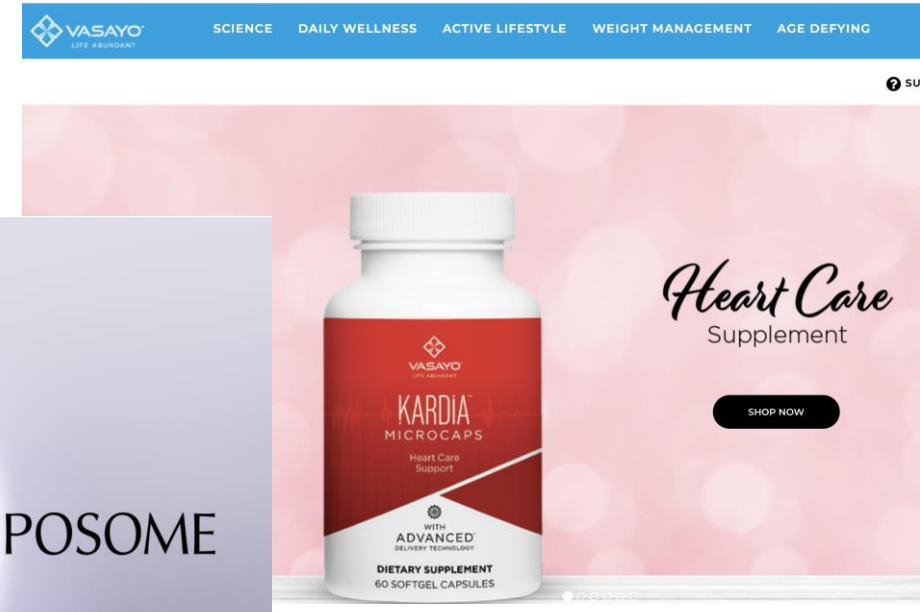
THINGS TO WATCH
MEDIA AND EVENTS
1921-2021
FOLLOW THE PLANTS
100 YEARS OF BOTANICAL EXCELLENCE FOR THE PHARMACEUTICAL AND NUTRACEUTICAL INDUSTRY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Improves and facilitates bioavailability of carried active components.


DECORTÉ
LIPOSOME
LIPOSOME

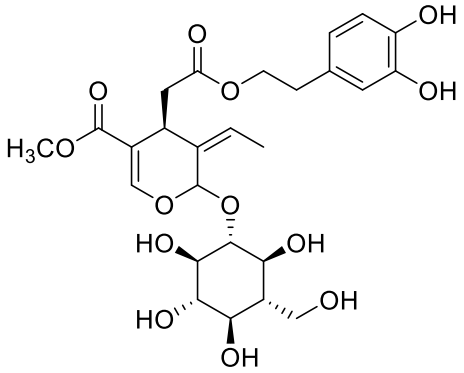
Olive leaf

- The Olive *(Olea europaea* L.*)* is a tree belonging to the family *Oleaceae.*

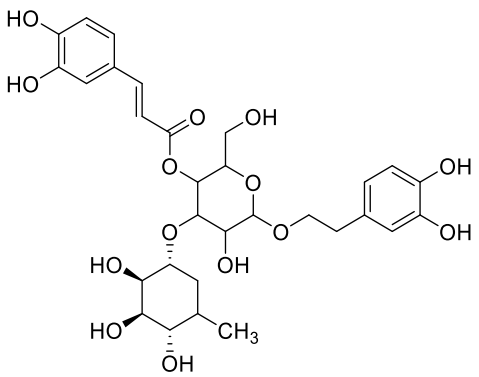
- Olive leaves have been a copious byproduct from the cultivation of olive trees and could be found in high amounts in the olive oil industry (10% of the total weight of the harvested olives).

Olive leaf and its various health-benefitting effects: a review study

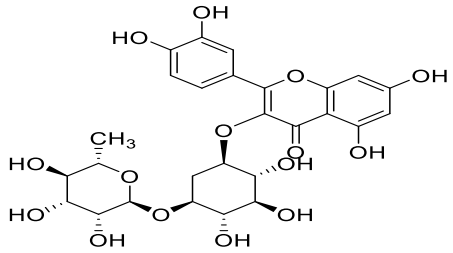
Structures of the main components in olive leaf



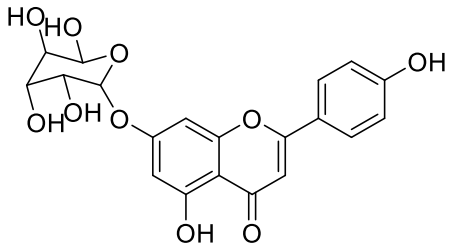
Oleuropein



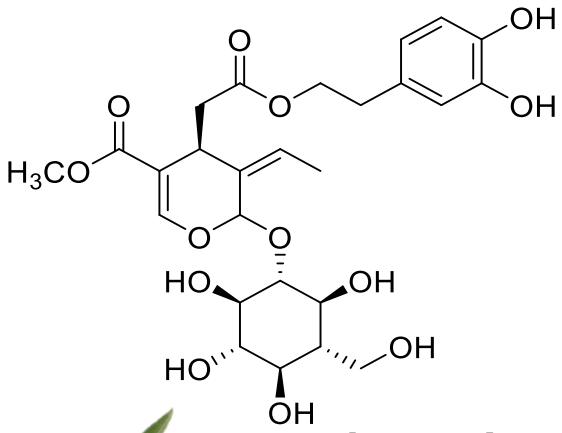
Rutin



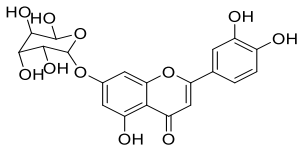
Apigenin-7-O-glucoside



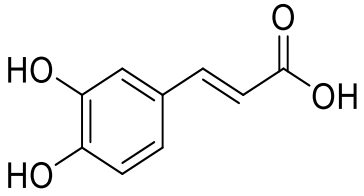
Luteolin-7-O-Glucoside



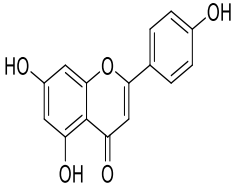
Verbascoside



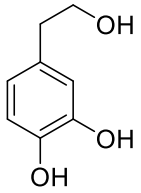
Caffeic acid



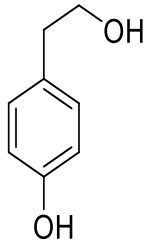
Apigenin



Hydroxy tyrosole

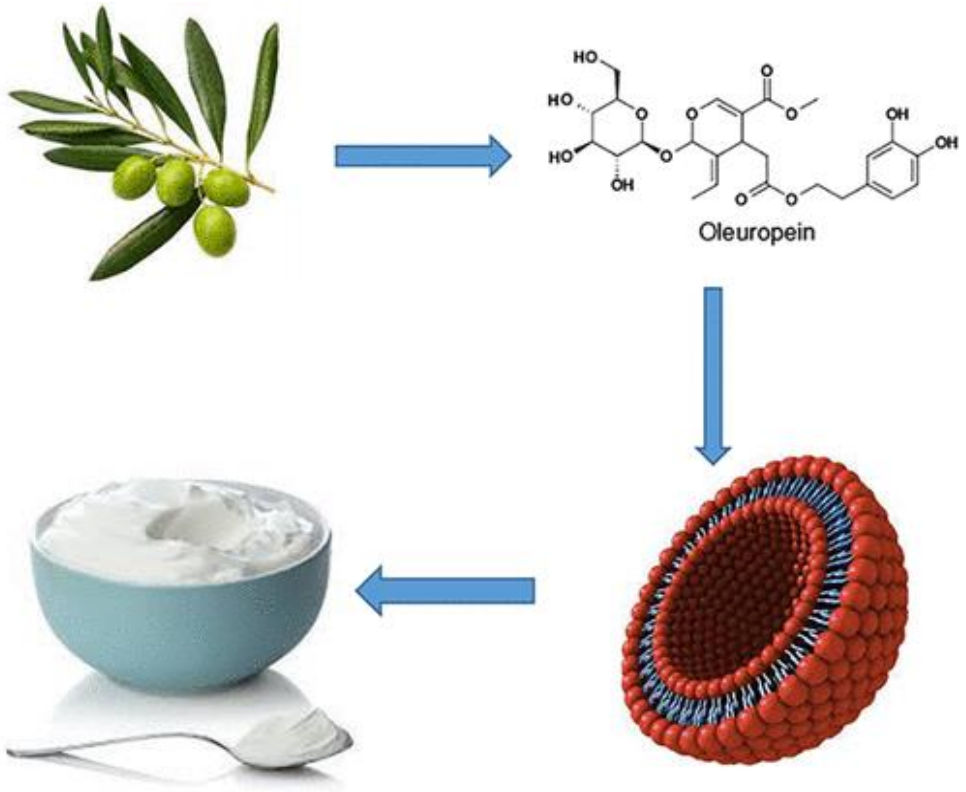


Tyrosole

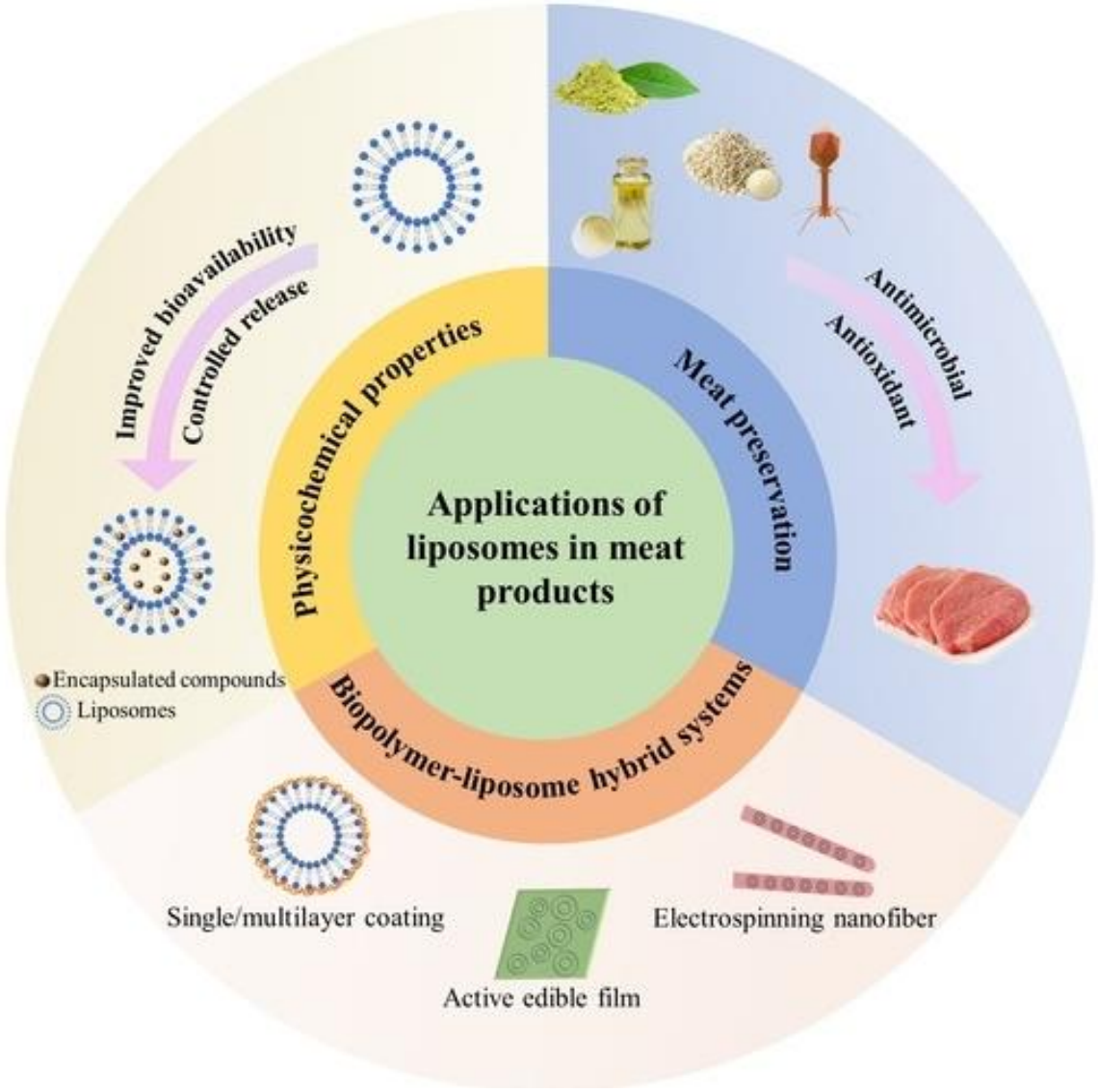


Vanilin

Nanoliposomes applications in food industries



Enriched yogurt by olive leaf
nanoliposomes



Tavakoli, H., et al (2018). *Journal of Agricultural and food chemistry*, 66(35), pp.9231-9240.
Huang, L., (2022). *Foods*, 11(19), p.3017.

Workflow

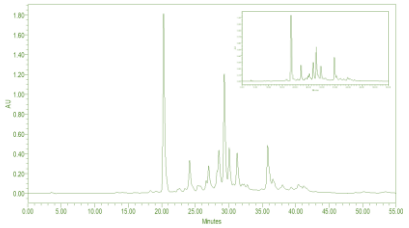
Enrichment

Crude Herbal Extract

Enrichment Procedure

Natural enrich fraction

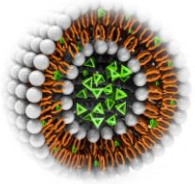
Evaluation of Crude extract and Phenolic Enrich Fraction by HPLC



First Coating

Liposome

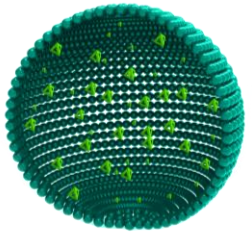
Prepare a Phytosome Mother Solution



Encapsulation

Sample Preparation

Feeding to Spray Dryer

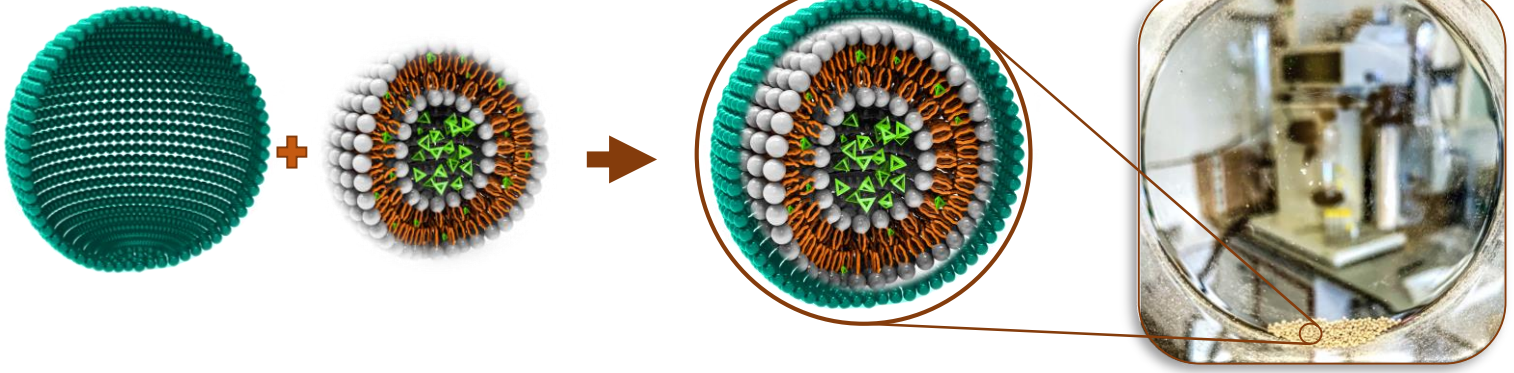


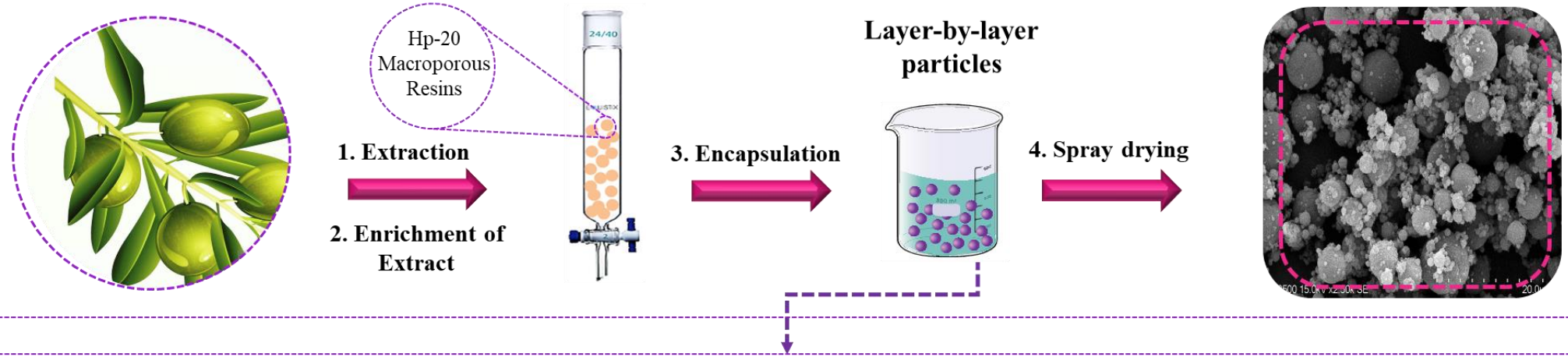
Second Coating

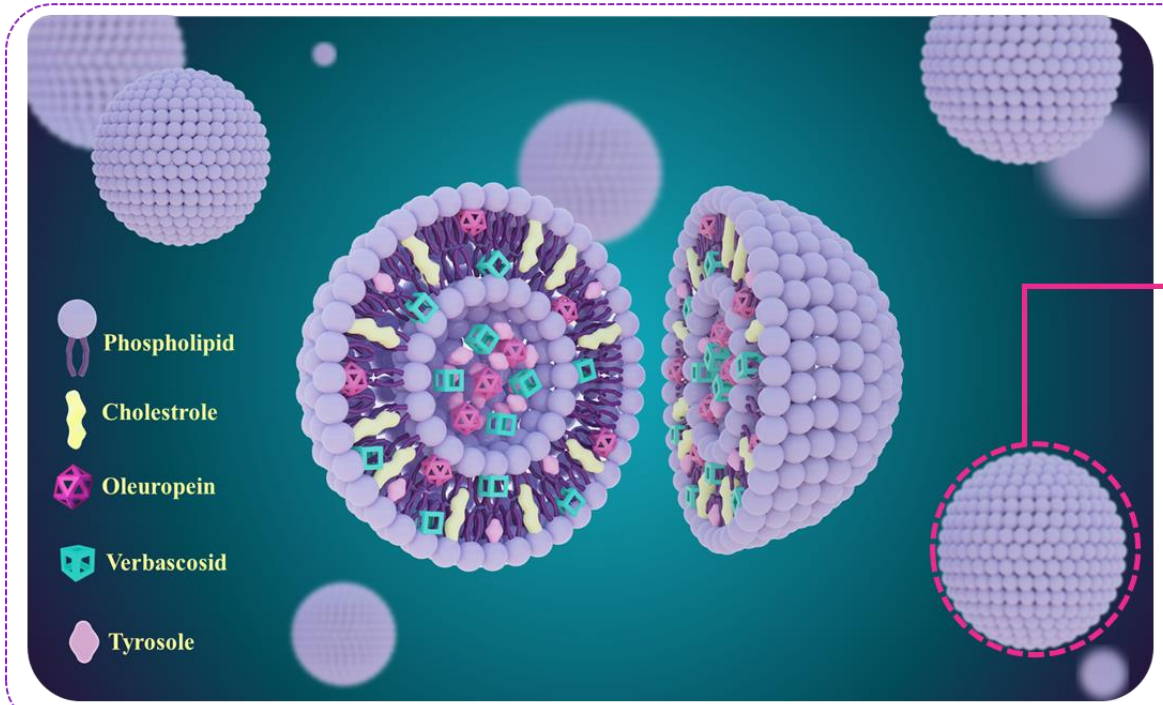
Phytosome Coating by Natural Polymer

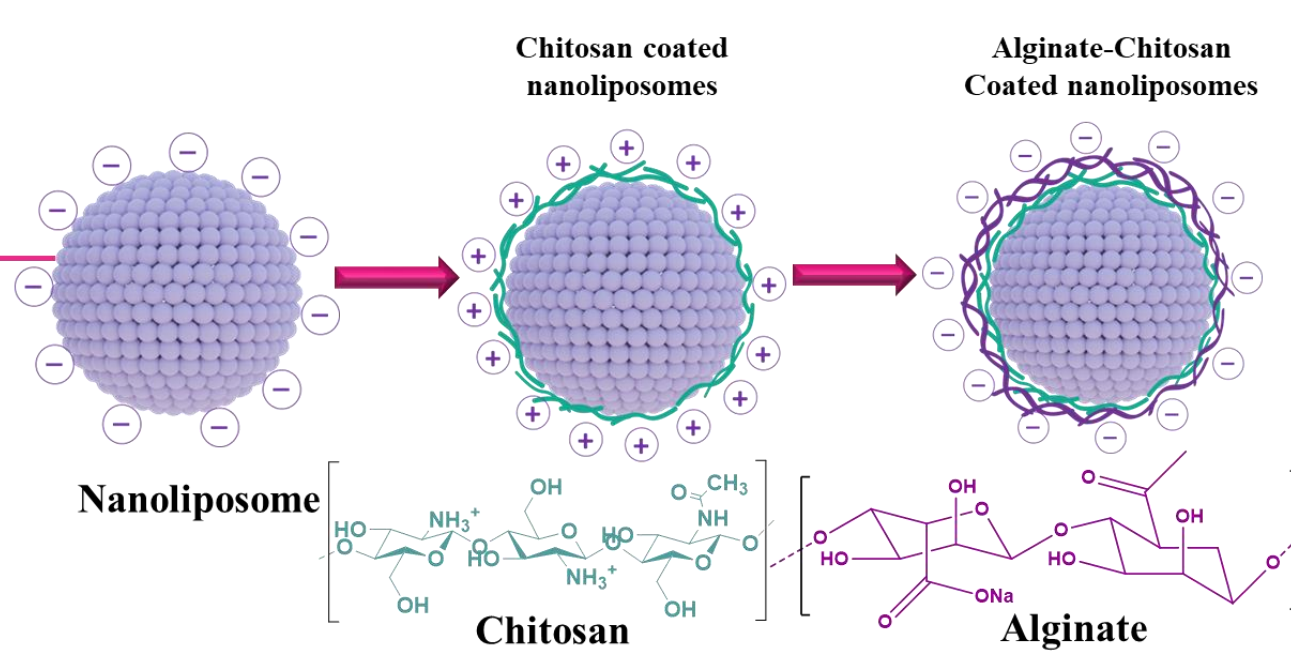
Adding a solution of Natural polymer to Phytosome mother solution

Feeding to Spray Dryer




Hp-20
Macroporous
Resins
1. Extraction
2. Enrichment of
Extract
3. Encapsulation
Layer-by-layer
particles
4. Spray drying


Phospholipid
Cholestrole
Oleuropein
Verbascosid
Tyrosole

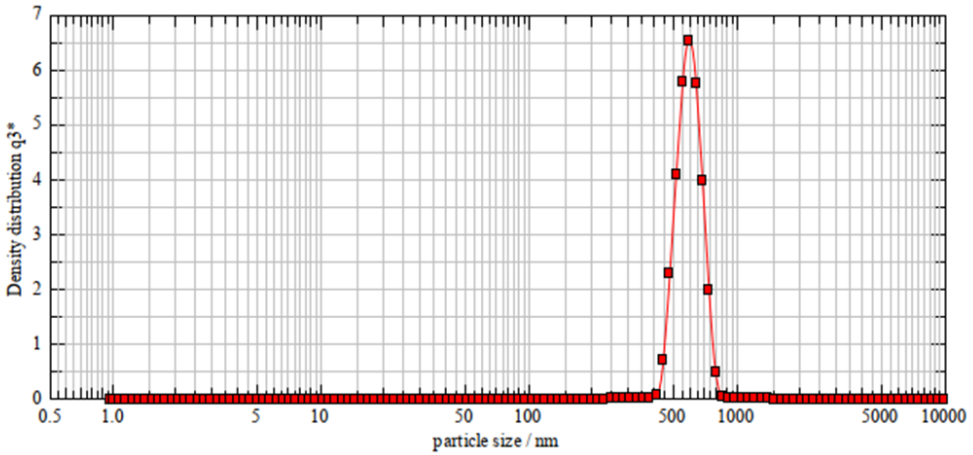

Chitosan coated
nanoliposomes
Alginate-Chitosan
Coated nanoliposomes
Nanoliposome
Chitosan
Alginate

DLS spectra

Al 0.1%

x_{10} = 424.18 nm x_{50} = 515.30 nm x_{90} = 761.04 nm SMD = 531.17 nm VMD = 559.44 nm
x_{16} = 436.31 nm x_{84} = 718.61 nm x_{99} = 924.26 nm S_V = 11.30 m²/cm³ sd = 135.05 nm

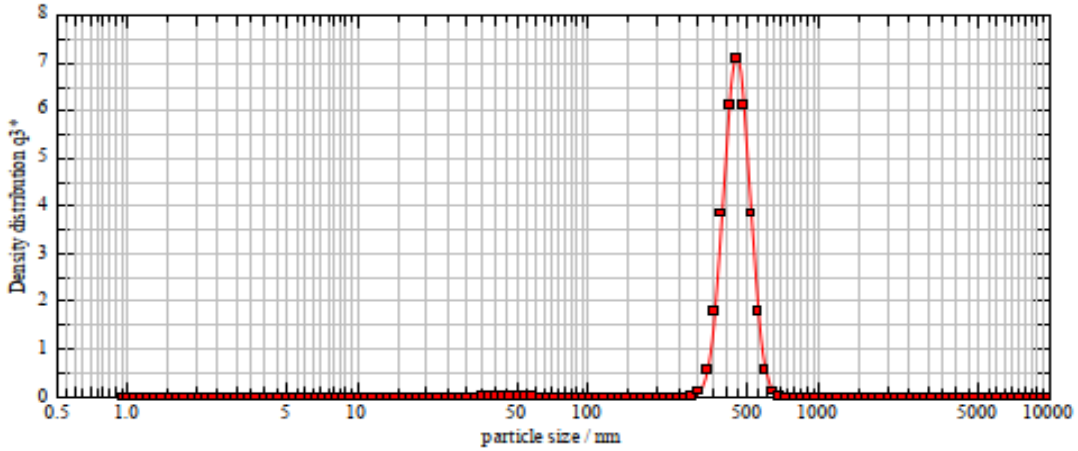
Width = 405.47 nm PDI = 405.47 nm / 559.44 nm



Al 0.25%

x_{10} = 374.29 nm x_{50} = 442.57 nm x_{90} = 523.10 nm SMD = 438.90 nm VMD = 446.22 nm
x_{16} = 388.09 nm x_{84} = 504.66 nm x_{95} = 598.03 nm S_V = 13.67 m²/cm³ sd = 57.23 nm

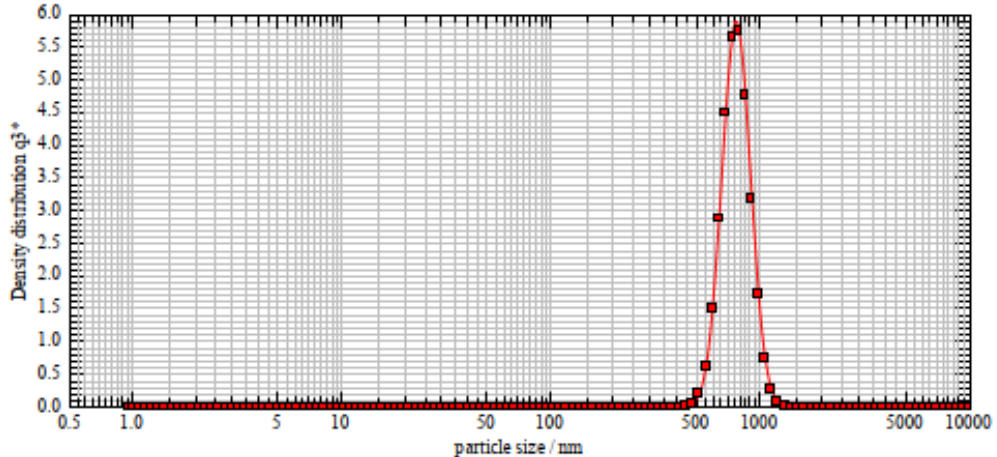
Width = 193.11 nm PDI = 193.11 nm / 446.22 nm



Al 0.5%

x_{10} = 626.57 nm x_{50} = 767.27 nm x_{90} = 938.04 nm SMD = 758.36 nm VMD = 776.81 nm
x_{16} = 657.06 nm x_{84} = 898.24 nm x_{95} = 1093.88 nm S_V = 7.91 m²/cm³ sd = 121.08 nm

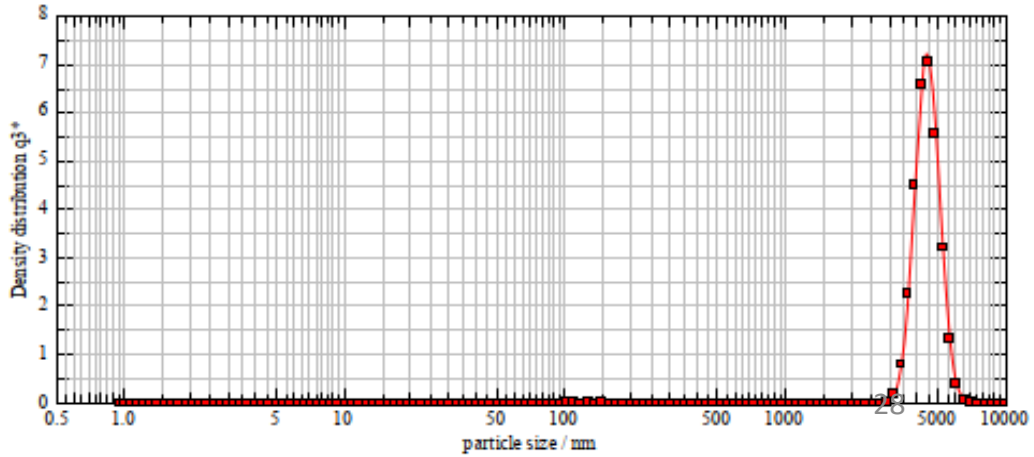
Width = 403.67 nm PDI = 403.67 nm / 776.81 nm



Al 1%

x_{10} = 3754.00 nm x_{50} = 4418.35 nm x_{90} = 5227.79 nm SMD = 4379.20 nm VMD = 4453.08 nm
x_{16} = 3875.26 nm x_{84} = 5010.54 nm x_{95} = 5936.45 nm S_V = 1.37 m²/cm³ sd = 566.87 nm

Width = 1878.80 nm PDI = 1878.80 nm / 4453.08 nm

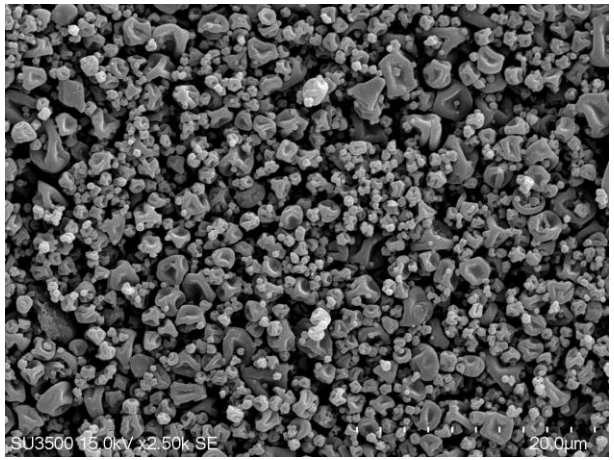


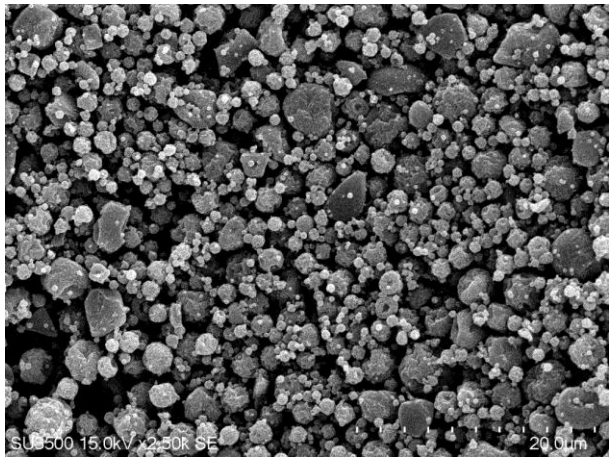
Liposome + Chitosan 0.5%

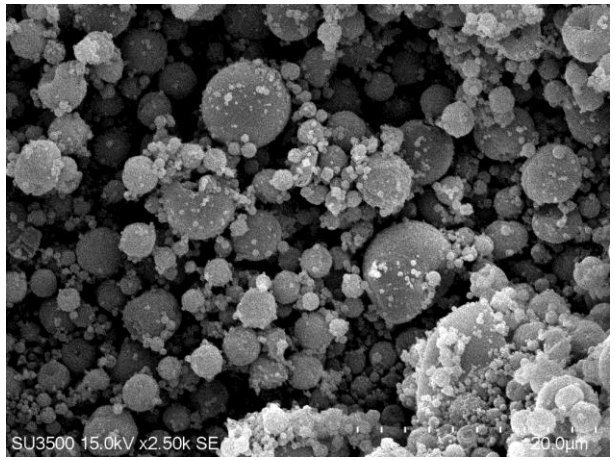
Liposome + Chitosan 1%

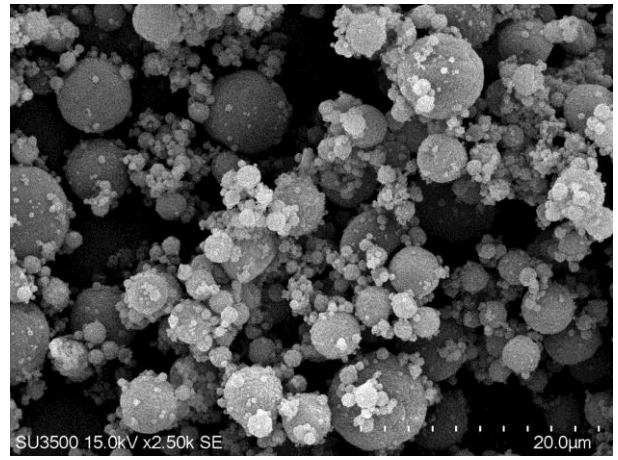
Liposome+ Chitosan 2%

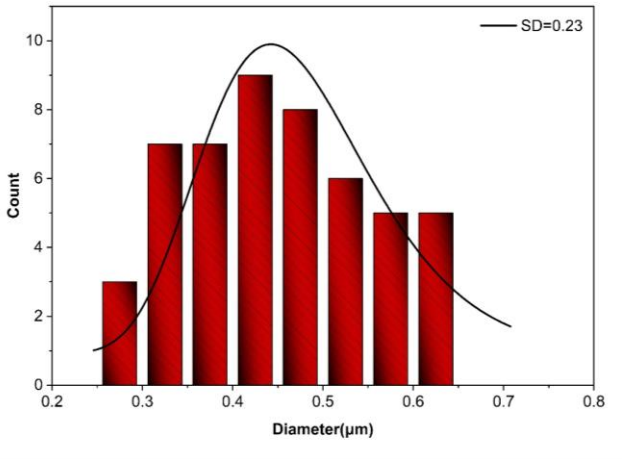
Liposome+ Chitosan 4%

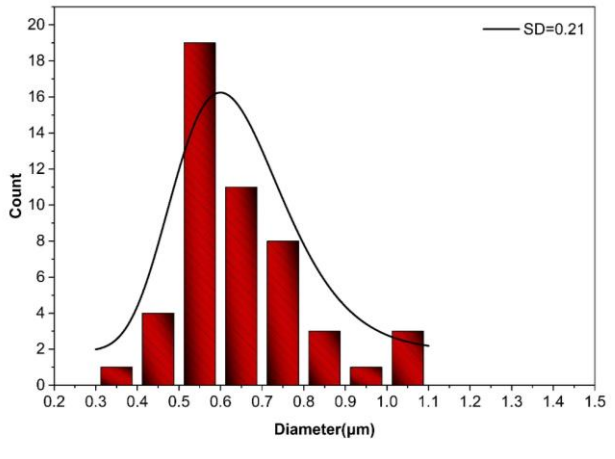


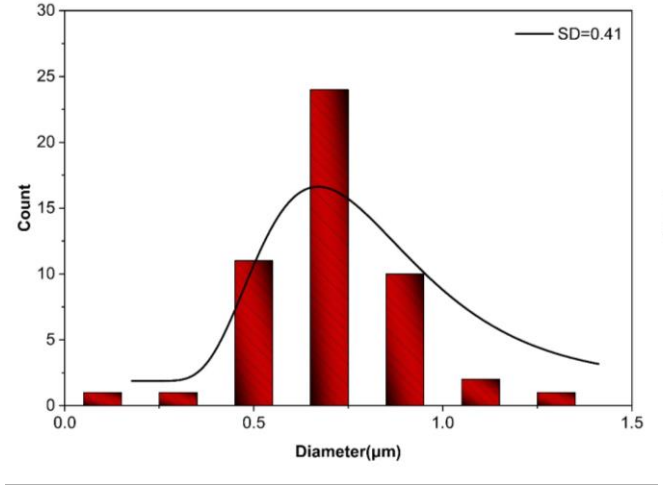


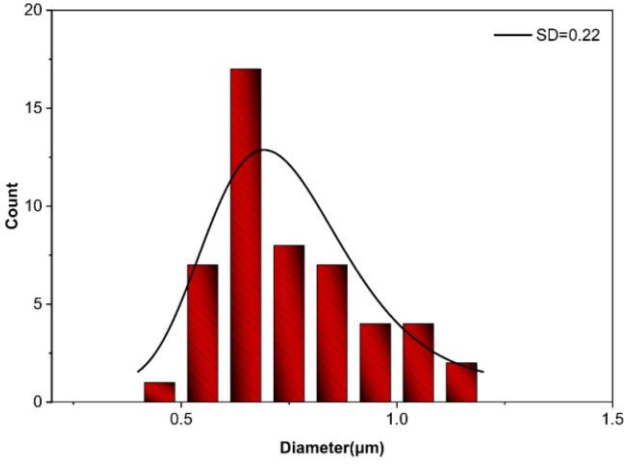






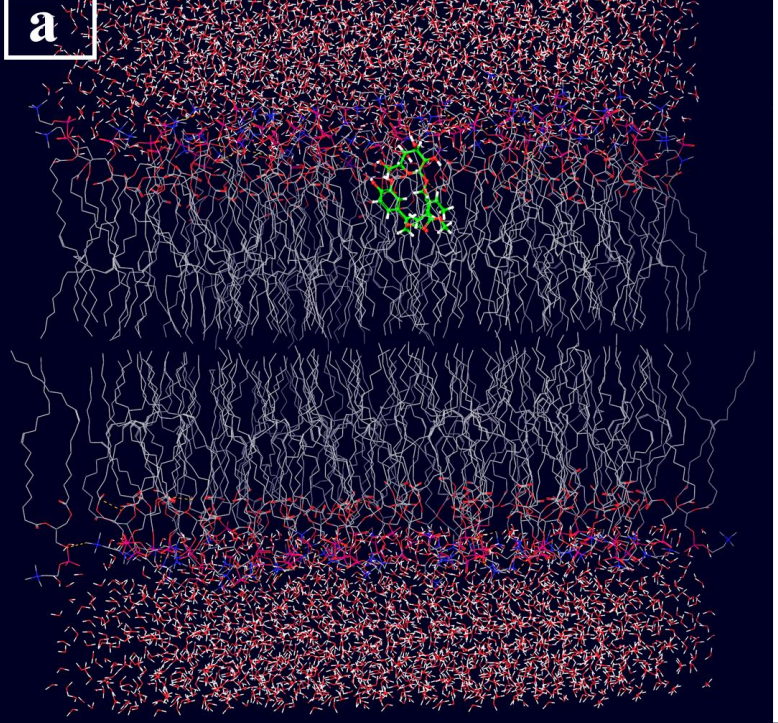


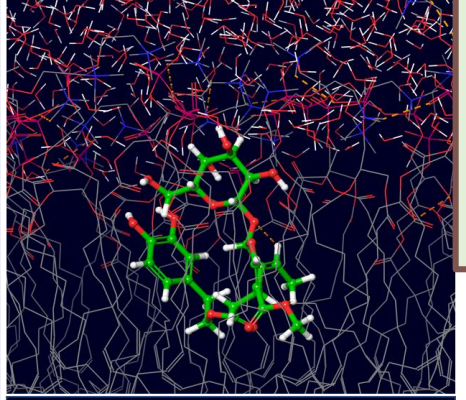


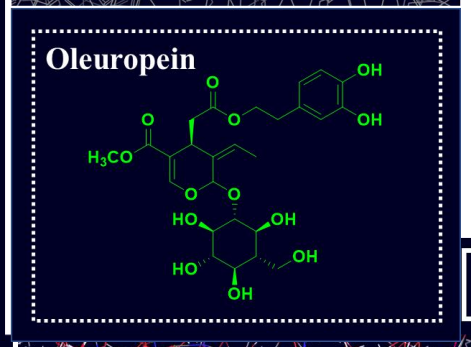


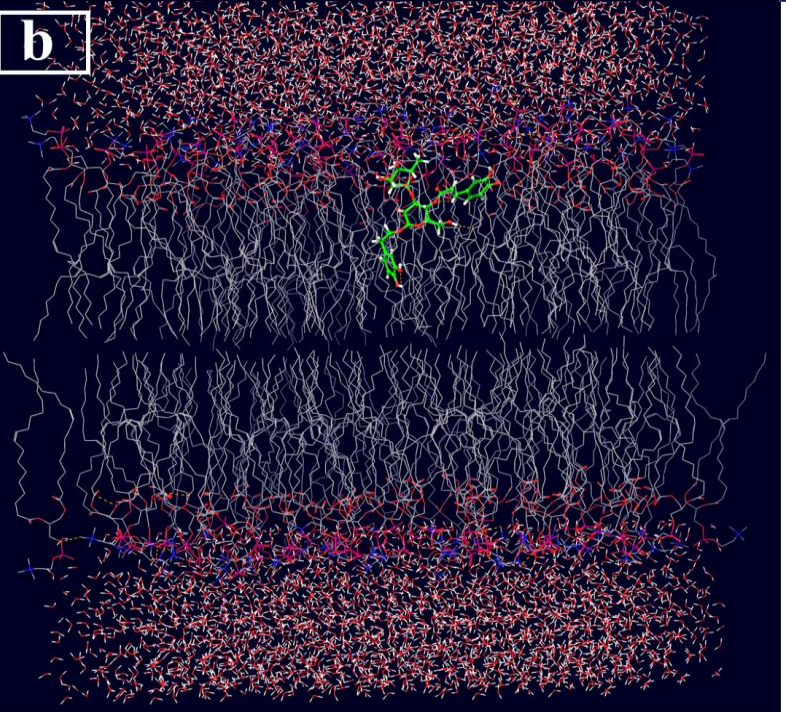
Simulation of interaction of active compounds olive leaf extract

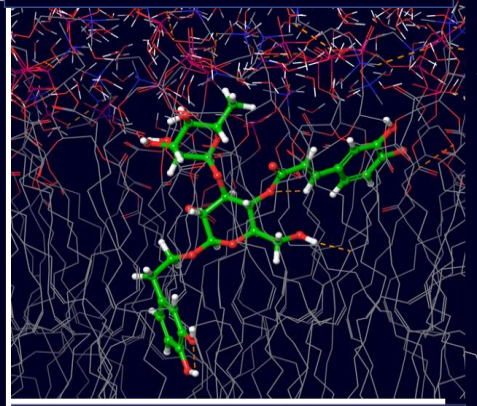
Components	Docking score (Kcal/mol)
Oleuropein	-8.332
Verbascoside	-7.652
Tyrosole	-4.589

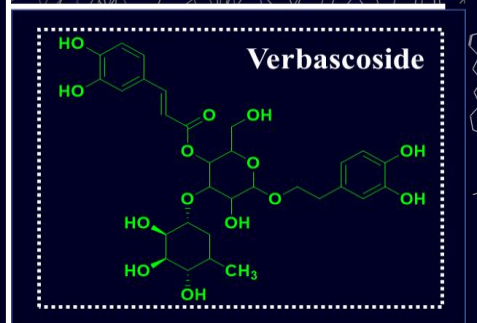


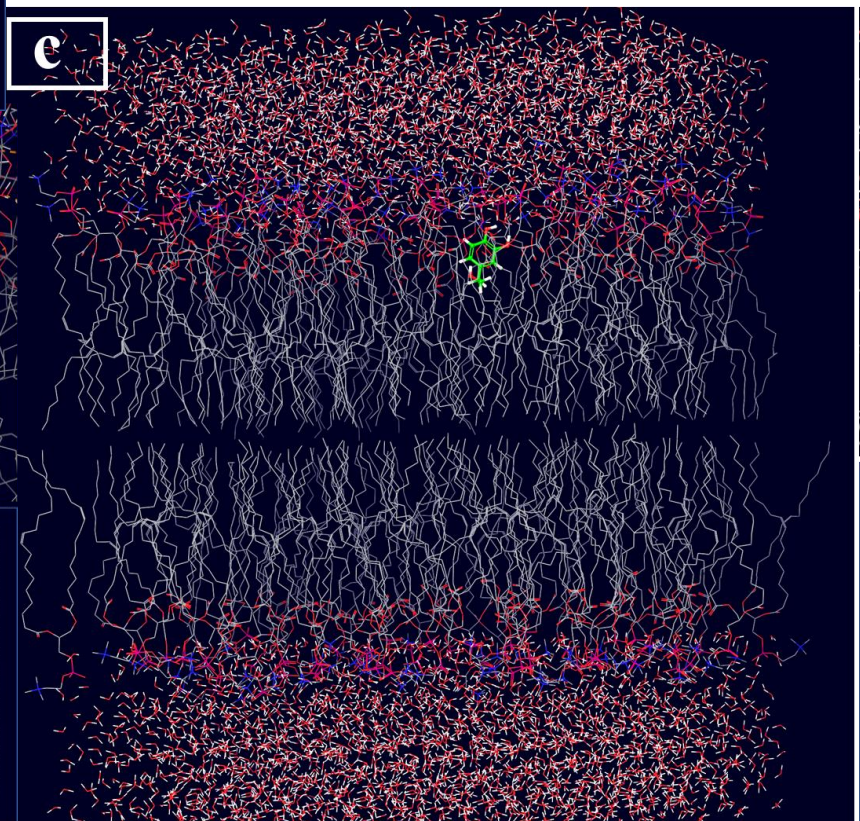


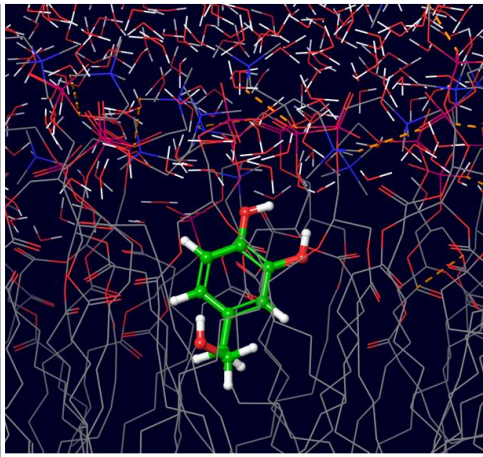


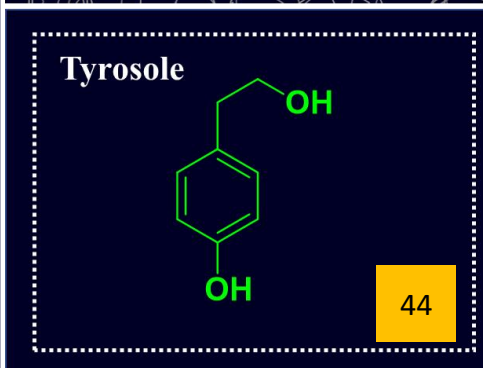


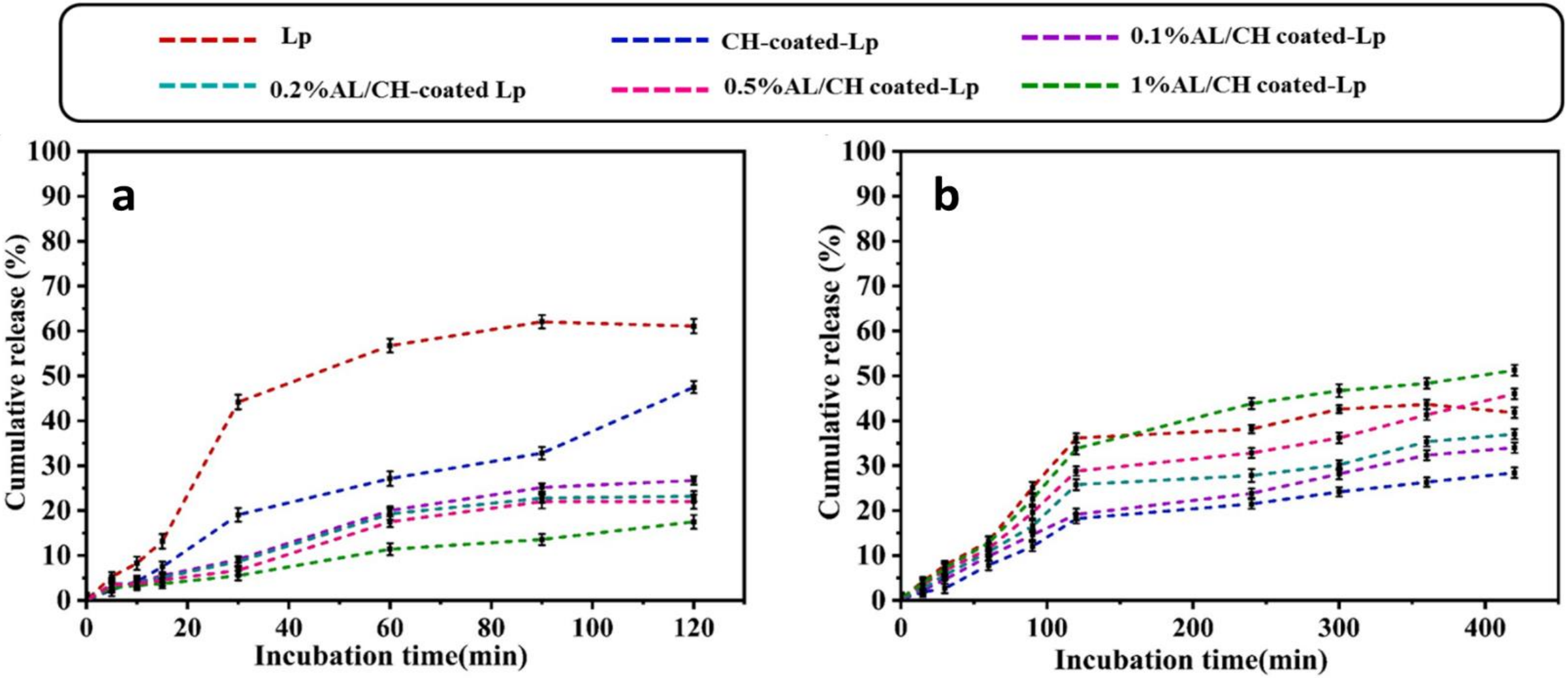












In vitro release profiles of OLE from the liposome samples at pH of 1.2 (**a**) and 6.8 (**b**). Lp: Liposome; CH: Chitosan; AL: Alginate

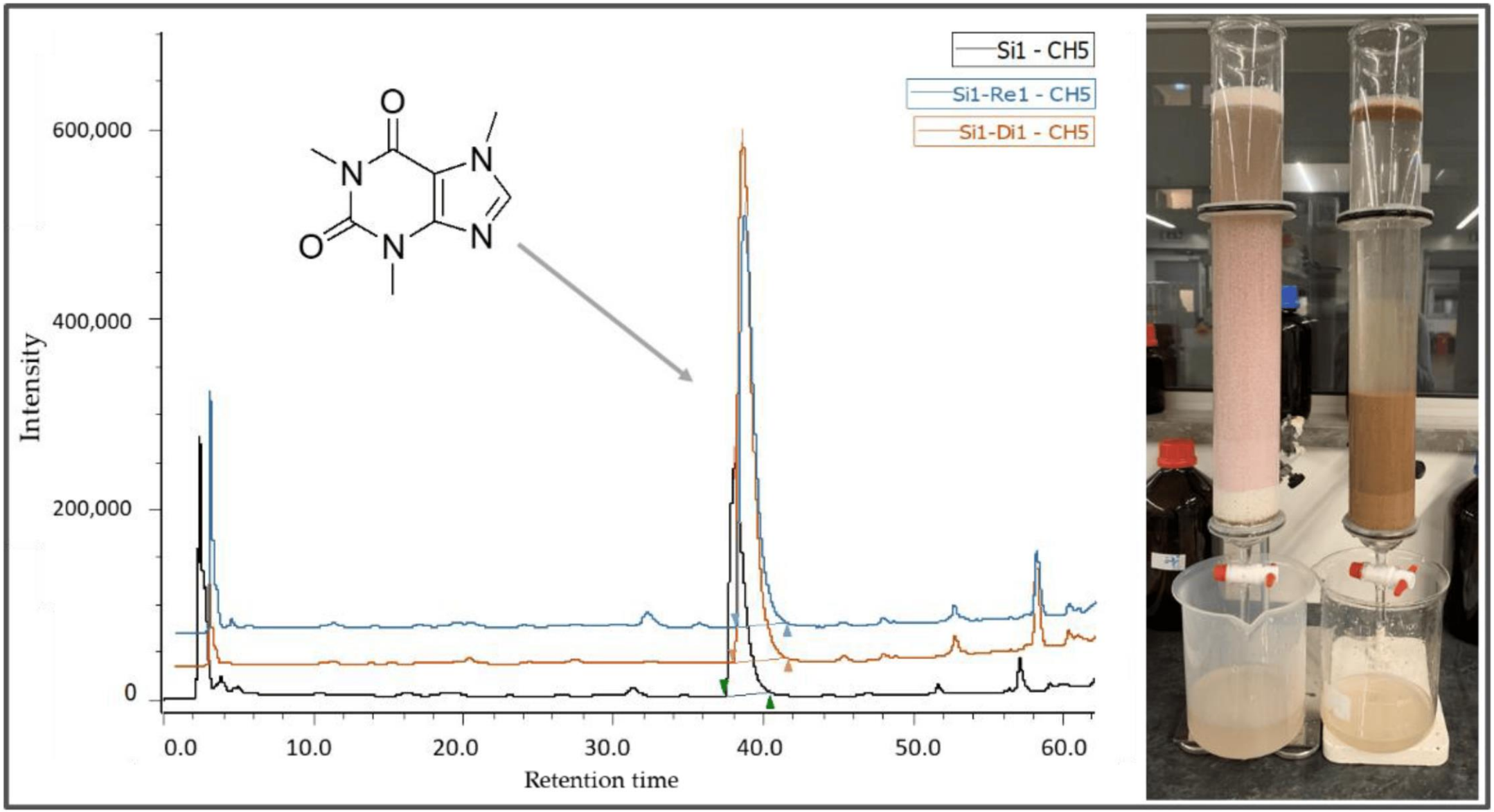
Caffeine Sources for industry

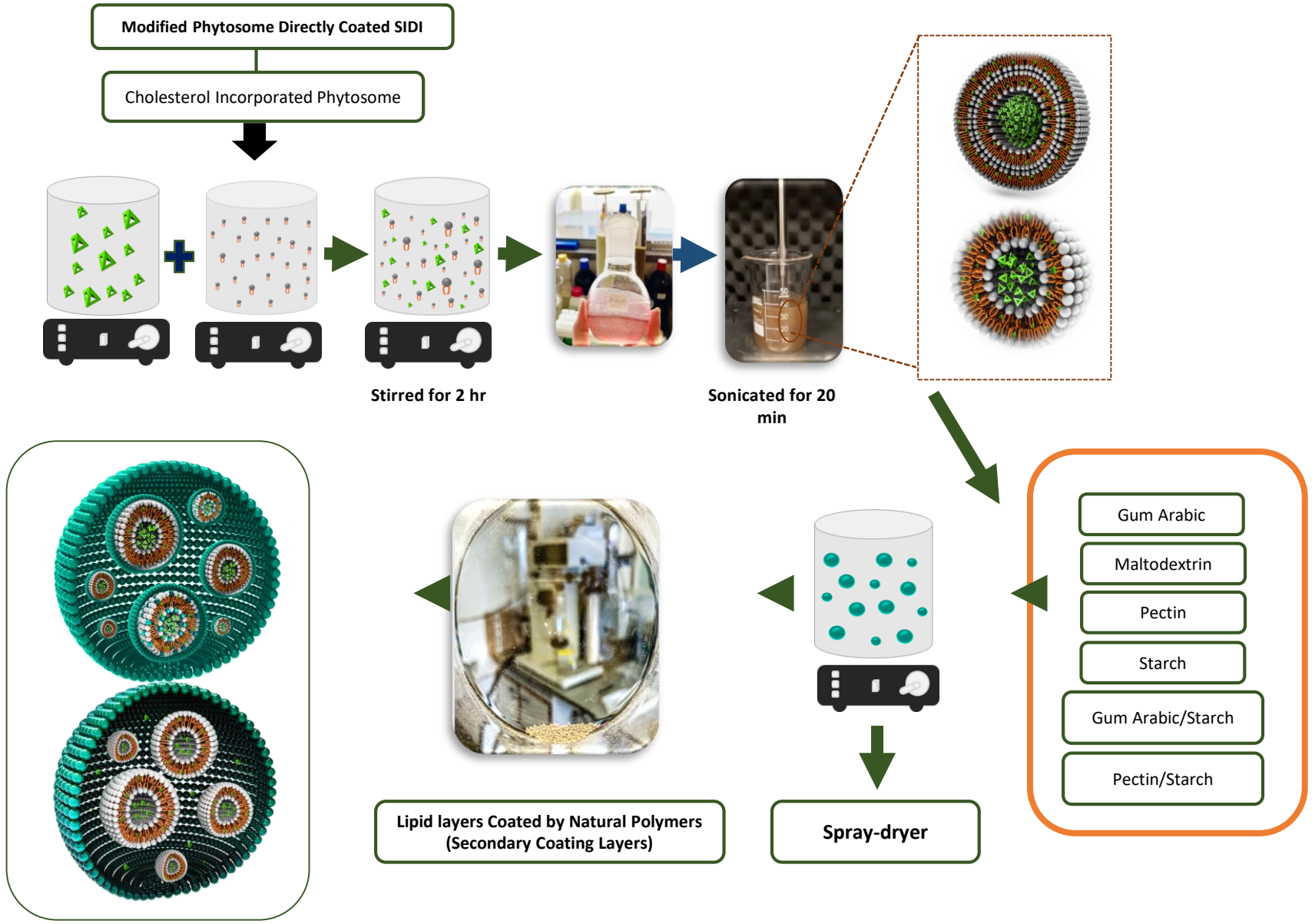
Coffee cherries

Coffee beans

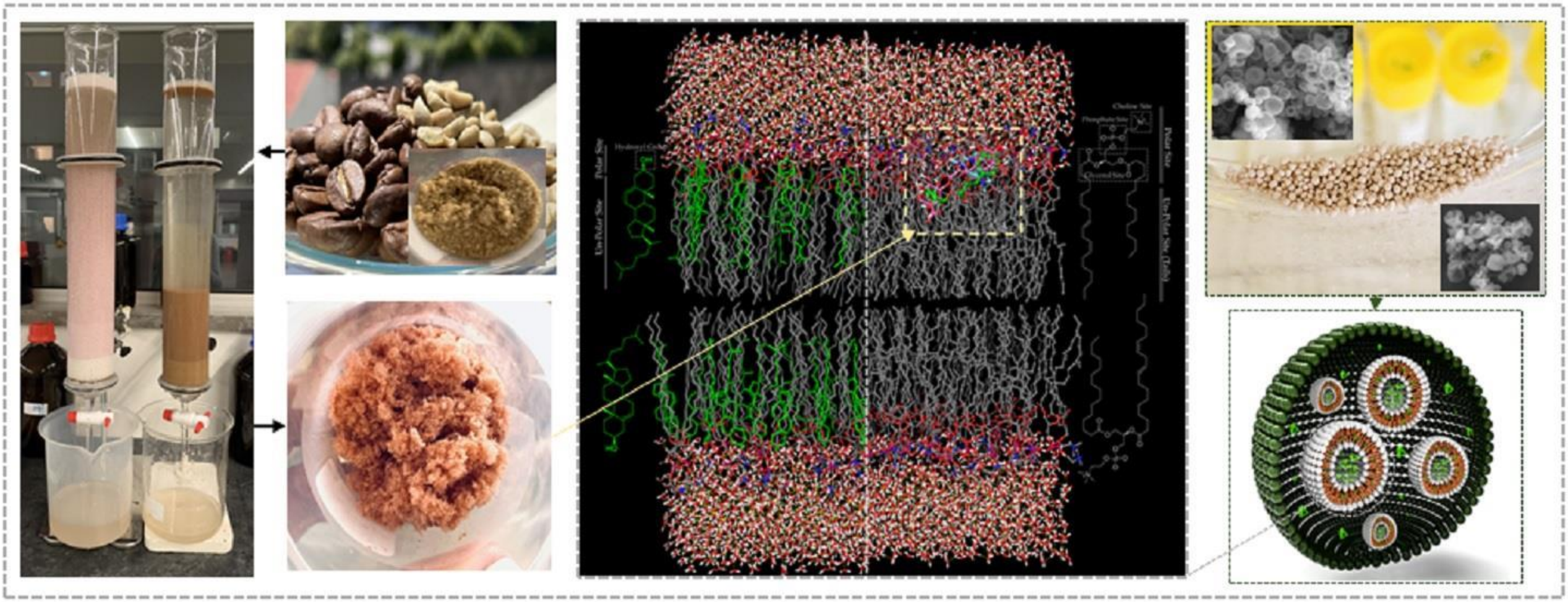
Coffee silverskin

Coffee silverskin (CS) is a thin, papery layer that covers the coffee bean and is a byproduct of the coffee roasting process. It has potential applications in **functional foods, cosmetics, nutraceuticals, …**


Si1 - CH5
Si1-Re1 - CH5
Si1-Di1 - CH5
600,000
400,000
200,000
0
Intensity
0.0
10.0
20.0
30.0
40.0
50.0
60.0
Retention time
O
N
N
O
N
N

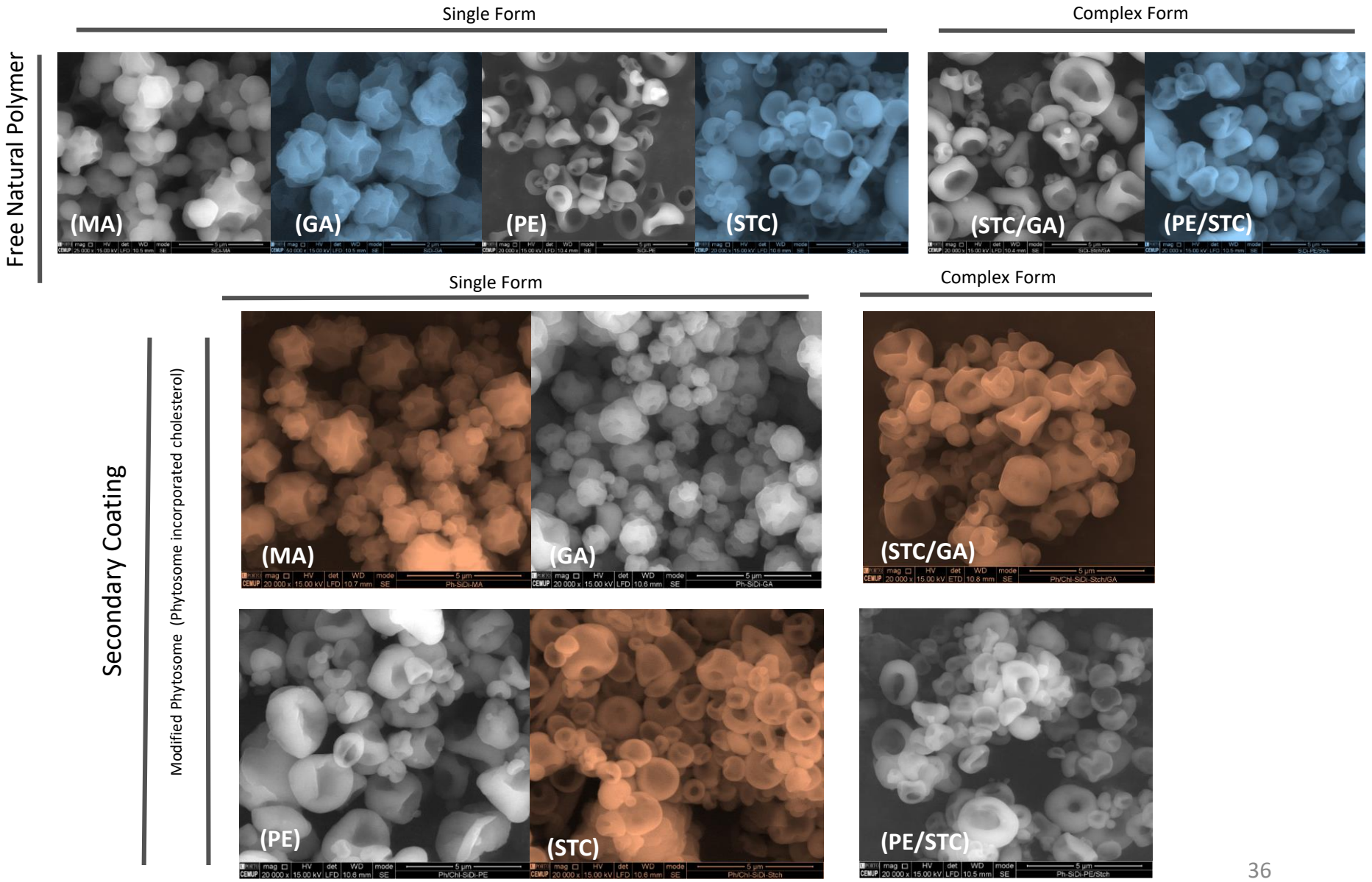

Modified Phytosome Directly Coated SIDI
Cholesterol Incorporated Phytosome
Stirred for 2 hr
Sonicated for 20 min
Gum Arabic
Maltodextrin
Pectin
Starch
Gum Arabic/Starch
Pectin/Starch
Spray-dryer
Lipid layers Coated by Natural Polymers (Secondary Coating Layers)

Formulation of Nano/Micro-Carriers Loaded with an Enriched Extract of Coffee Silverskin



Pharmaceutics **2022**, *14*(1), 112;
https://doi.org/10.3390/pharmaceutics14010112

Silverskin: Particles Morphology



MA; Maltodextrin, GA; Gum Arabic, PE; Pectin, STC; Starch, STC/GA; Starch and Gum Arabic, PE/STC; pectin and starch

Future Outlook and Emerging Trends

Enhanced Efficacy: Nanocosmetics improve the delivery and effectiveness of active ingredients, offering superior performance compared to traditional formulations.

Consumer Benefits: Lightweight textures, better absorption, and longer-lasting effects enhance user satisfaction.

Versatility: Applicable across various product categories, including anti-aging, sunscreens, hair care, and fragrances.

Technological Innovation: Advances in nanocarriers like liposomes, nanoemulsions, and lipid nanoparticles continue to expand formulation possibilities.

Safety and Regulation: Strict evaluation of nanoparticle safety is essential to address consumer concerns and meet regulatory standards.

Market Potential: Growing consumer demand for innovative and effective solutions positions nanocosmetics as a key driver of growth in the personal care industry.

Future Opportunities: Continued research into biodegradable and sustainable nanocarriers will enhance product development while addressing environmental concerns.

Nanocosmetics exemplify how cutting-edge technology can revolutionize the industry by combining innovation, efficacy, and consumer-centric design


دانشگاه شهید بهشتی
پژوهشکده گیاهان و مواد اولیه دارویی




Thank you for your attention!