

# Emerging Technologies for Better Nutrition

Dr. N. Ramasubramanian  
VR Food tech Private Limited

# The Flow

- ▶ Introduction
- ▶ Micro Emulsions
- ▶ Nano Technology
- ▶ Synbiotics in Mineral absorption
- ▶ Transdermal Patches
- ▶ Challenges

# Introduction

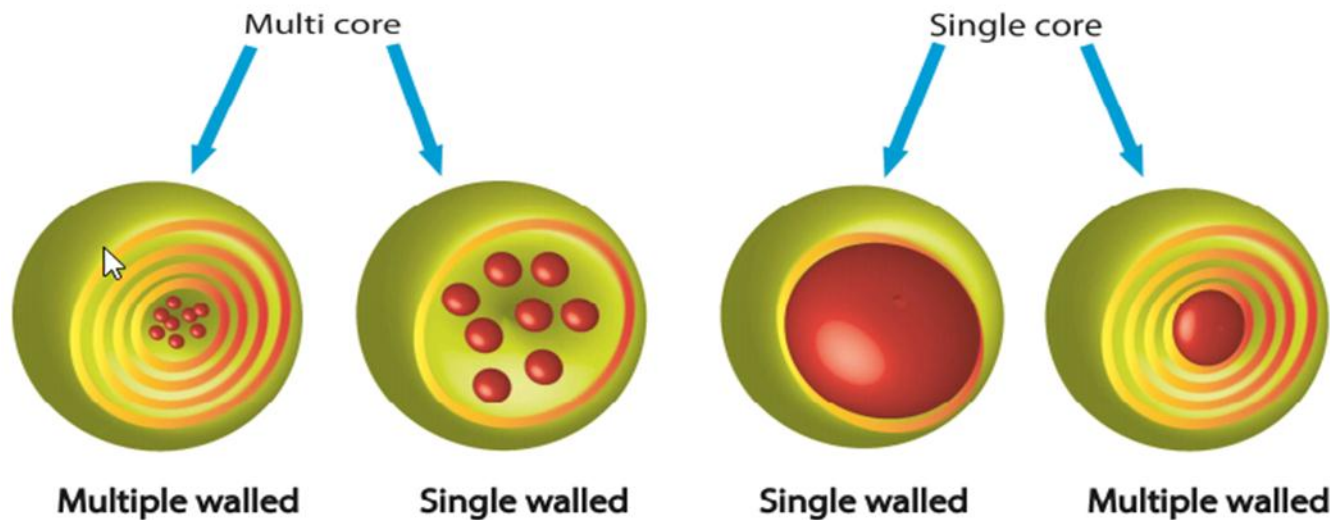
- ▶ Better nutrition
  - ▶ Affordability
  - ▶ Accessibility
  - ▶ **Availability - Bio Availability**
- ▶ WHO – Zinc requirements vary from 3 to 9.8 mg per day with bioavailability from High to low. Indian RDA for Zinc is 12 mg
- ▶ **Bioavailability** is defined as the proportion of a nutrient that is digested, adsorbed, and utilized in normal metabolism.
- ▶ Improved bioavailability reduces the daily requirement

## Bio Availability

- ▶ Impediments
  - ▶ Other Constituents of foods and its interaction with nutrients
  - ▶ Harsh gastric conditions
  - ▶ The complex gastrointestinal mucous layer
- ▶ An efficient release and delivery of functional food ingredients is subjected to two main phenomena.
  - ▶ The delivery system has to adhere to the Gastrointestinal mucus layer.
  - ▶ The functional food ingredients included in a delivery formulation must diffuse through the mucus layer in order to reach the blood stream.

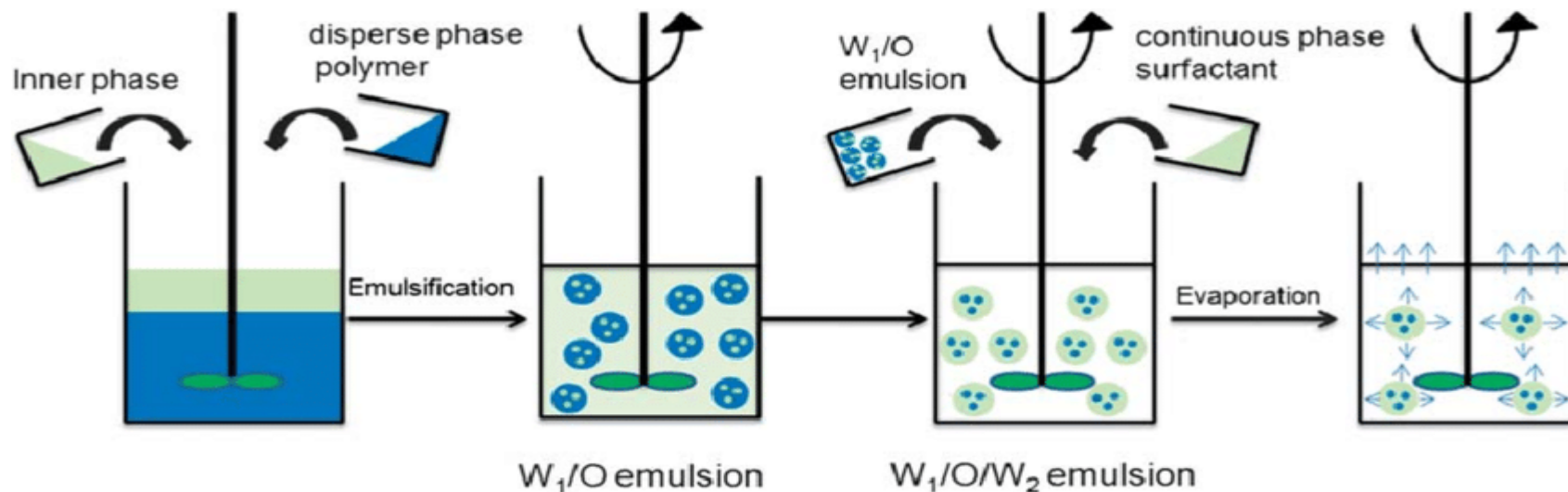
# Microemulsion

- ▶ Increased residence time leading to enhanced adsorption
- ▶ Improved intimacy of contact with various biological membranes
- ▶ Improved bioavailability through the protection of bioactive molecules from Physical and chemical degradation
- ▶ Targeting and localization of a release device at a specific site.



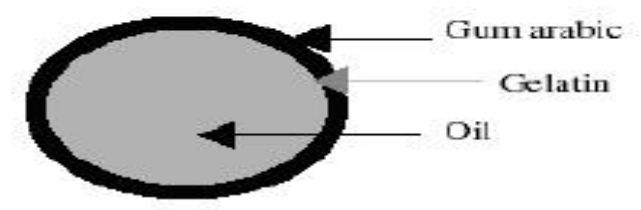
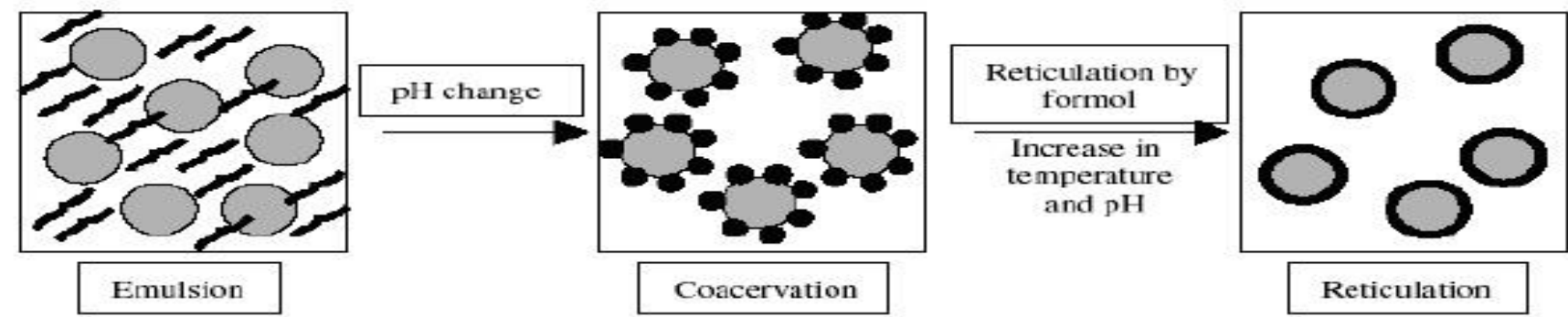
## Double Emulsion System

- ▶ Multiple emulsion systems can be used in microencapsulation technology
- ▶ **Water-in-oil-in-water (W/O/W)** double emulsion systems have been used to encapsulate proteins and probiotics in hydrophilic environments
- ▶ **Oil-in-water-in-oil (O/W/O)** systems have been used to formulate controlled-release systems for essential oils and fish oils (PUFA)



# Coacervation

## Coacervation Formation



Gum arabic  
Gelatin  
Oil

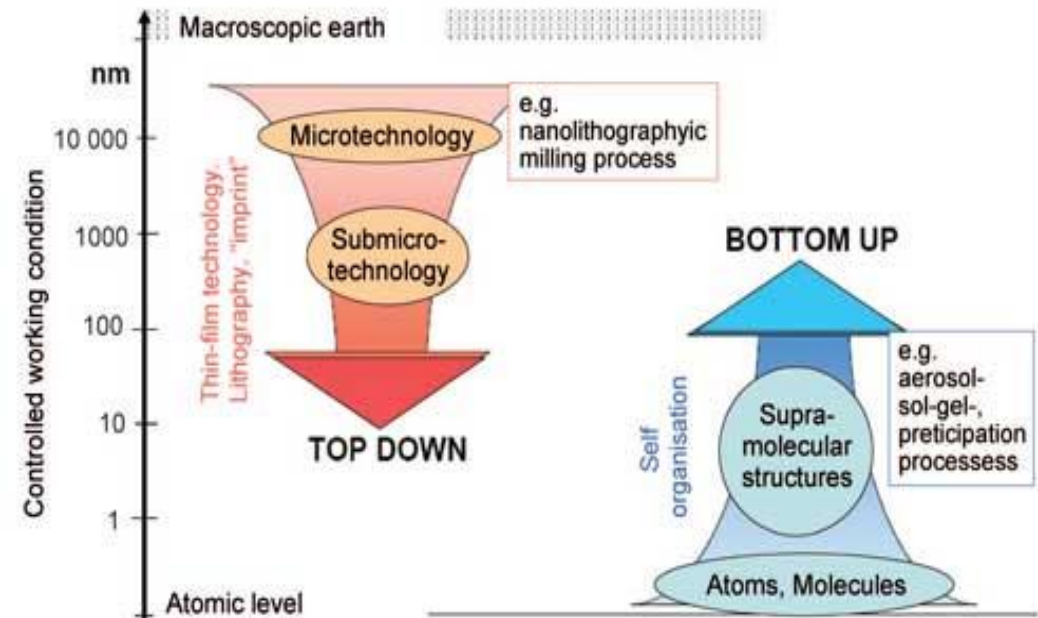
# Micro Emulsion Applications

Bioactive	Challenges	Solution
Polyphenols – Catechin and others	<ul style="list-style-type: none"> <li>• Catechin is natural hydrophilic antioxidant molecule.</li> <li>• Low bioavailability is a result of its limited membrane permeability and degradation in digestion conditions</li> </ul>	An increase in the stability and bio accessibility of <b>catechin</b> encapsulated within a double emulsion
Vitamin B12	Vitamin B12 is prone to degradation in solutions, particularly when exposed to light.	Encapsulated in water-in-oil-in-water double emulsions (w1/o/w2) to produce a functional cream. Preventing the release of vitamin during in vitro gastric digestion.



# Nano Technology

- ▶ Technology that measure, manipulate or incorporate material or features with dimension between 1 to 100 nm
- ▶ Properties of nano particles are very distinct from the bulk due to very high surface area.
- ▶ Copper - Opaque to Transparent
- ▶ Nano Application
  - ▶ As nano particle
  - ▶ As nano emulsion

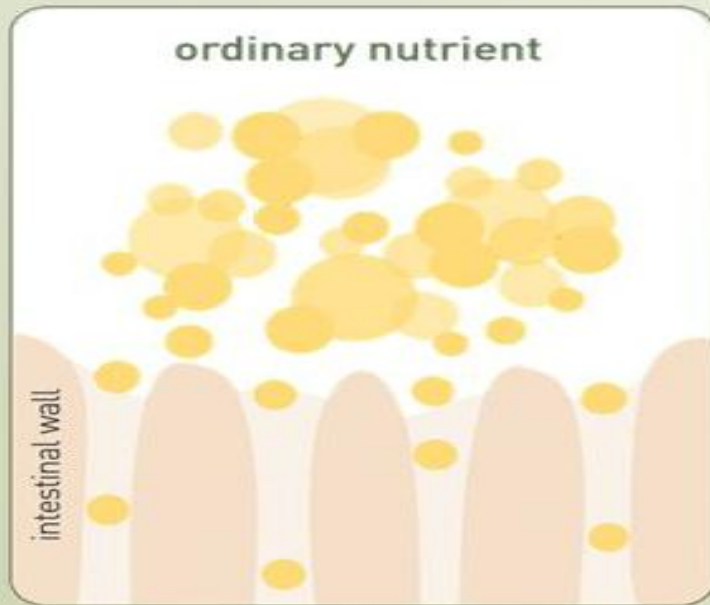


# Nano Particles/Emulsions/Encapsulation

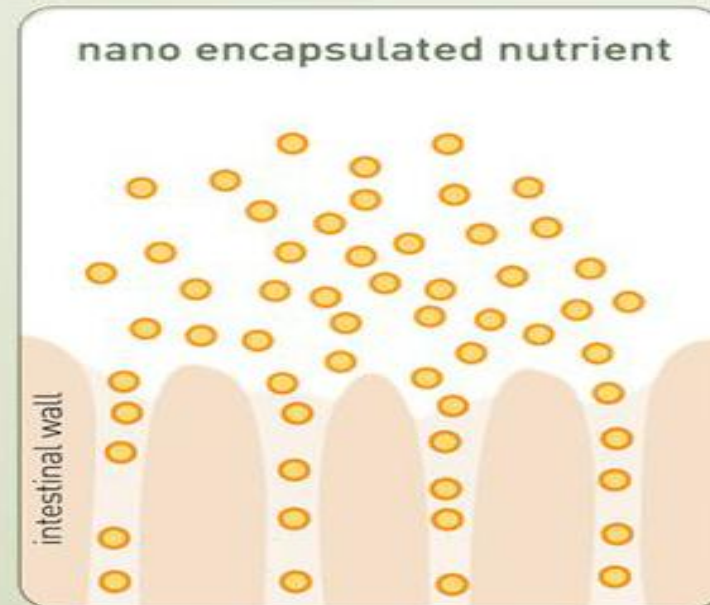
- ▶ Emulsions of the order of less than 100 nm

## How do nano-nutrients work?

Fat-soluble nutrients like carotenoids and coenzyme Q<sub>10</sub> tend to cling together in the digestive tract, making them difficult to absorb.



Nano-encapsulated nutrients do not cling together, thus increasing their contact with the absorptive-cells of the digestive lining, hence increasing absorption.



# Nano-based Products in market

Product	Details	Application
<b>Nanoceuticals™ Slim Shake Chocolate</b>	Pure cocoa infused “Nanoclusters”	To enhance taste without extra sugar. Infused cocoa flavoured nano silica increases the absorption on taste buds to enhance the chocolate flavour.
<b>Nanotea</b>	Nano-selenium rich tea	Nano-tea can release effectively all the excellent essences of the tea, thus boosting the absorption

Product	Details	Application
<p><b>NanoCurcuminoids™</b></p>	<p>Curcuminoids encapsulated with Solid-lipid nanospheres</p>	<p>Enhance solubility and absorption, targeted delivery of curcuminoids therefore increased bioavailability</p>
<p><b>Nanotrim™</b></p>	<p>All natural, nano-scaled ingredients</p>	<p>Better absorption and availability</p>
<p><b>Fortified bread</b></p>	<p>Nanocapsules containing tuna fish oil (a source of omega-3 fatty acids). It is made available only when the nanocapsules reach the stomach</p>	<p>Delivery of omega-3 fatty acids</p>

Product	Details	Application
Maternal Water	Mineral water (without any chemical treatment) with nano colloidal silver ions	Especially for baby and mothers in the gestation period
24Hr Microactive <sup>®</sup> CoQ10	Nanosized CoQ10 and $\beta$ -Cyclodextrin matrix	<ul style="list-style-type: none"> <li>• More stability against heat and light, matrix showed a sustained release and showed better bioavailability than ordinary CoQ10 by a factor of 3.7.</li> </ul>

## Synbiotics in Mineral Absorption

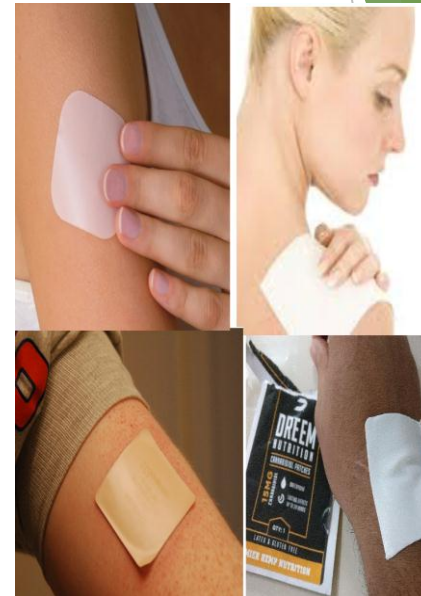
- ▶ Probiotics and prebiotics could be used to improve the absorption of micronutrients from ingested foods.
- ▶ Pro and Pre Biotics
  - ▶ Results produces short chain fatty acids lowering the pH
  - ▶ Increases mineral solubility
  - ▶ Activates the phytase enzyme thus making the minerals available
  - ▶ Results in the formation of soluble complexes leading to higher absorption

# Role of synbiotics in nutrient absorption

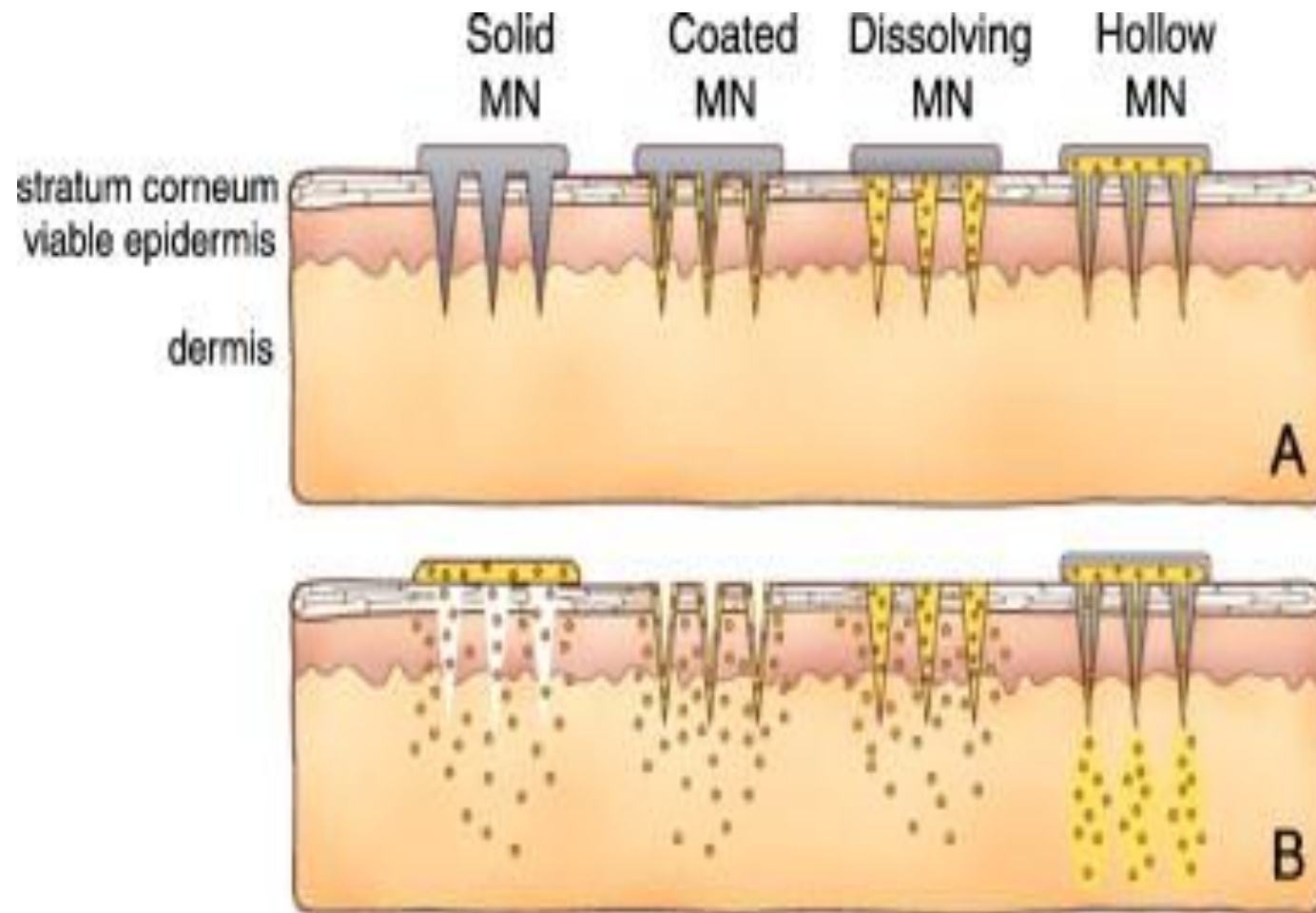
Study	Findings
Effects of <i>Bifidobacterium lactis</i> and prebiotic oligosaccharide added to milk on iron absorption	Iron status in young children could be improved significantly by intake of a milk-fortified with synbiotics.
Mineral absorption enhanced with GOS	Galacto oligosaccharide has proven to improve iron and calcium absorption when administered through juice and other foods
Bifidobacterium for promoting mineral absorption	<i>Bifidobacterium</i> spp. cultivated in milk was found to be a mineral absorption-promoting agent

# Transdermal Nutrient Delivery

- ▶ Better Bio Availability
- ▶ Sustained release
- ▶ By passes the harsh gastric conditions
- ▶ Patches – Passive absorption
- ▶ Third-generation delivery systems target their nutrients through skin's barrier layer using microneedles, thermal ablation, microdermabrasion, electroporation and cavitation ultrasound







# Jelly Drops for Elderly



Lewis Hornby

## Challenges

- ▶ Regulatory - Novel process
- ▶ Safety of nano particles
- ▶ Technology and Cost
- ▶ Focus to shift on bio availability - cannot just add and expect to do wonders

► Thank You