

Match Maker/ Sustainable Ingredients/ 3 Feb 2023

Polysaccharides based nanoemulsion for delivery of nutraceuticals

Lead Inventor: Dr Anirban Roy Choudhury

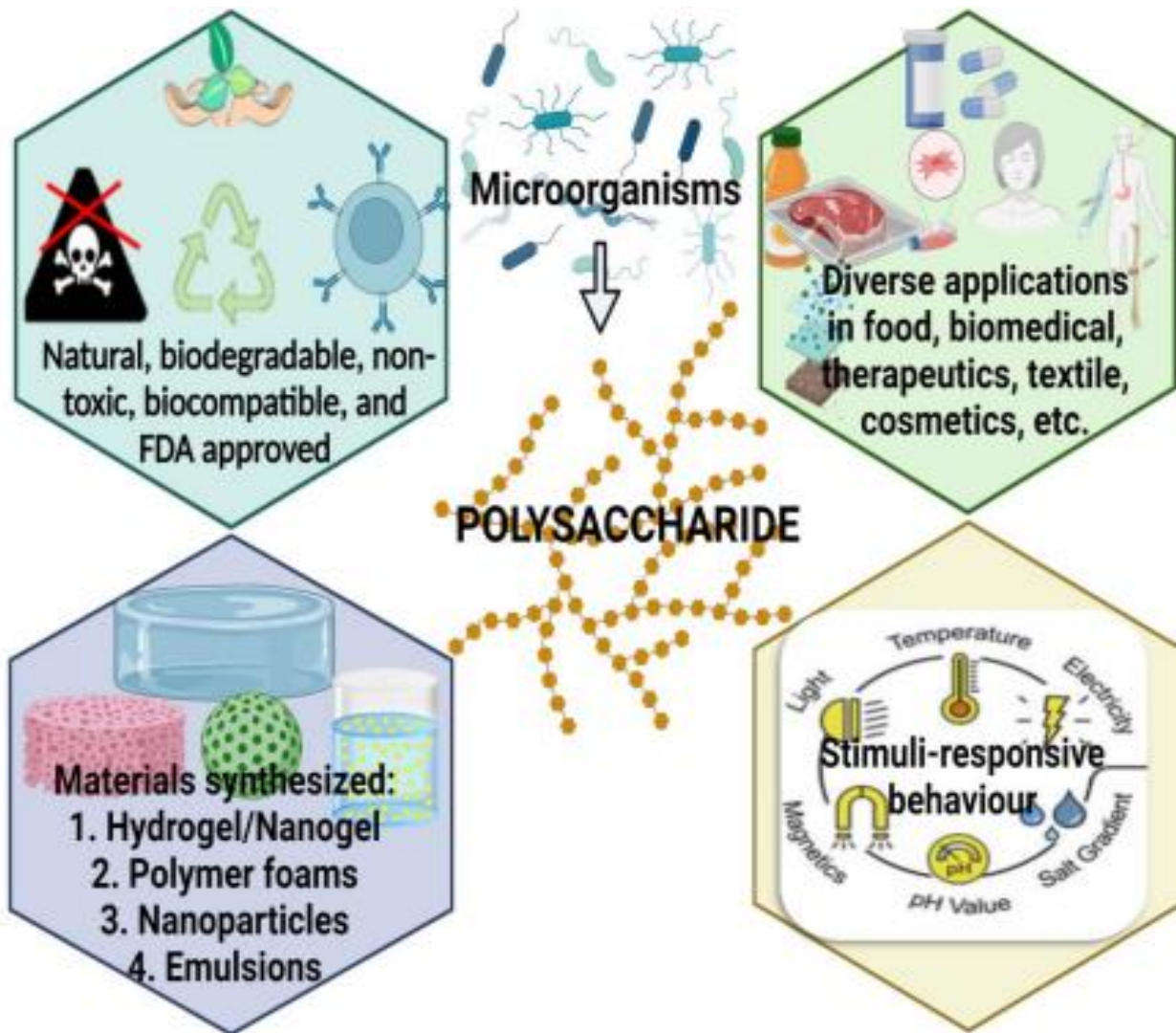
Organization: CSIR- Institute of Microbial Technology, Chandigarh

TechEx.in Case Manager: Kavita Parekh (kavita.parekh@venturecenter.co.in)

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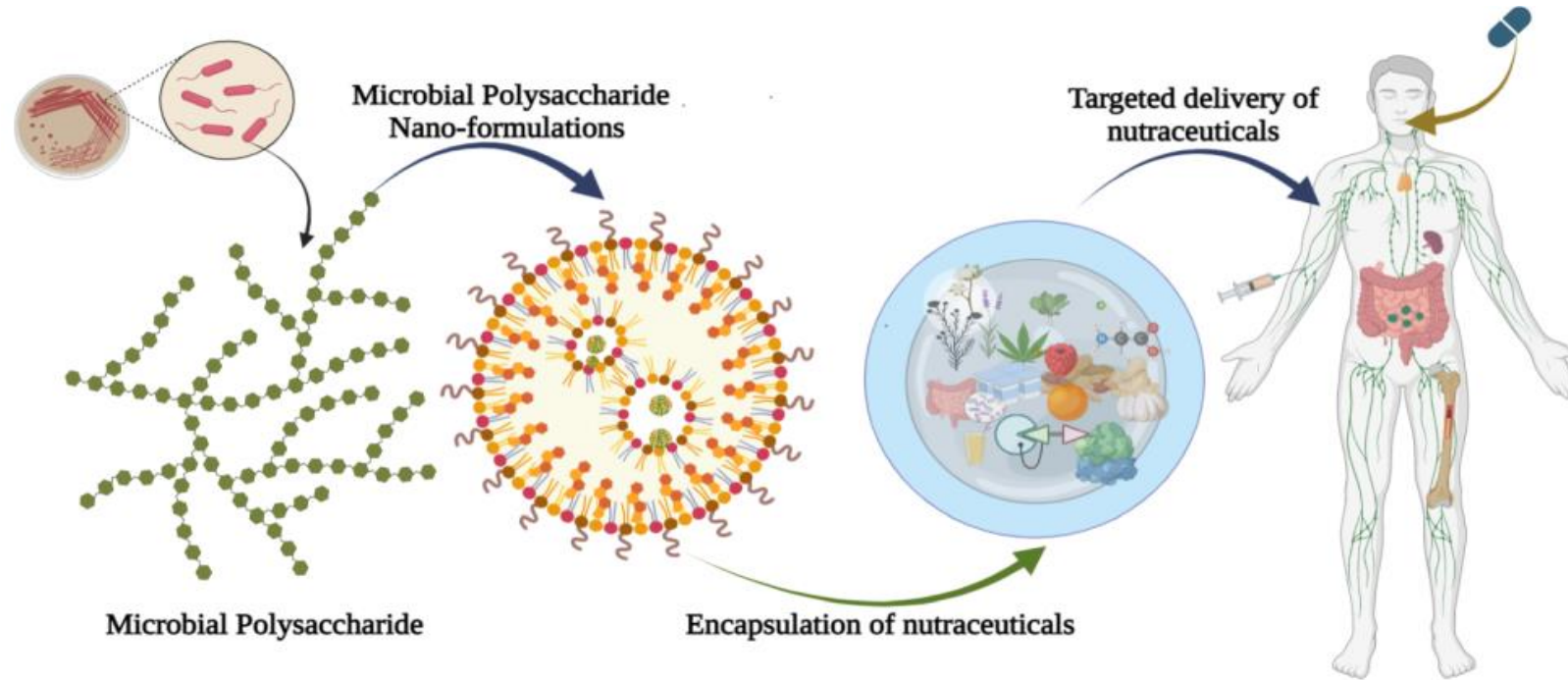


Why Polysaccharides?



- The chemical structure of a polysaccharide comprises monomers linked to each other through glycosidic linkages.
- In recent years, naturally obtained polysaccharides have gained popularity over synthetic polymers.
- The complex structures and high molecular weight of these polymers provide them stability in extreme environmental conditions.

Nano-formulations for nutraceutical delivery



Nano-formulations have diverse applications and advantages -

- Improve water dispersibility and reduce volatilization
- Size dependent properties.
- Enhancing chemical stability
- No undesirable flavor
- Controlled release of substances
- No adverse affect on properties of functional food.
- Constructed using diverse polysaccharides with diverse functional groups and properties.

Nano-formulations



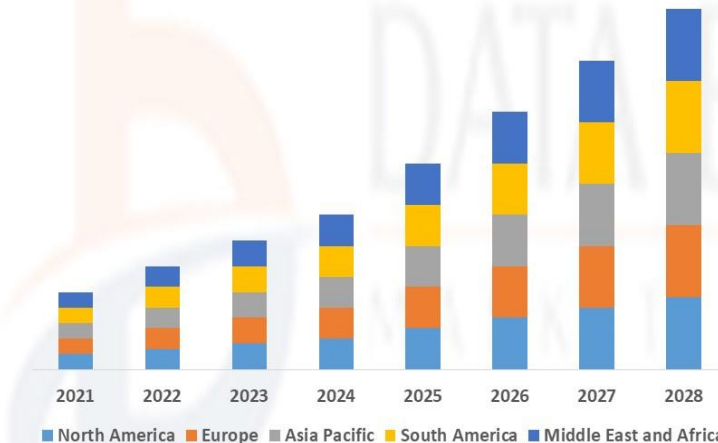
The Opportunity

The nanoencapsulation market was valued at a USD 7.8 million in 2021 is expected to reach the value of USD 14.76 million by 2029, at a CAGR of 8.3% during the period of 2022-2029 (Source: Data Bridge)

Factors driving the growth:

1. Increased solubility, leads to higher bioavailability
2. Improved shelf stability
3. Controlled release of actives

Global Advanced Phase Change Material Market is Expected to Account for USD 4,179.88 Million by 2028



Global Advanced Phase Change Material Market, By Regions, 2021 to 2028



DATA BRIDGE MARKET RESEARCH



Major global players: Cargill, Incorporated, BASF SE, DuPont , DSM , Friesland Campina, Kerry Ingredion International Flavors & Fragrances Inc. IFF (U.S.), Symrise (Germany), Sensient Technologies Corporation etc.

Who should be interested and why?

Industries interested in a strategy for developing stable emulsion of water insoluble nutraceuticals without use of chemical surfactants like TWEEN 20



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Who?

Why?

Nutraceutical companies looking for biocompatible and biodegradable formulations of polysaccharides for nutraceuticals

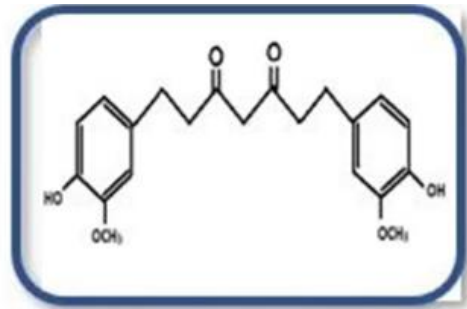
Synthetic emulsifiers may have certain qualms upon its application in food or pharmaceutical industry owing to the recent trend of green consumerism of undesirable color/flavor/taste, preservation of unstable constituents, and site-specific release of encapsulated ingredients at a controlled time and rate

Industries interested in developing new combination of nano formulations for multiple nutraceutical deliveries.

Enhancing the functionality, delivery and processed foods

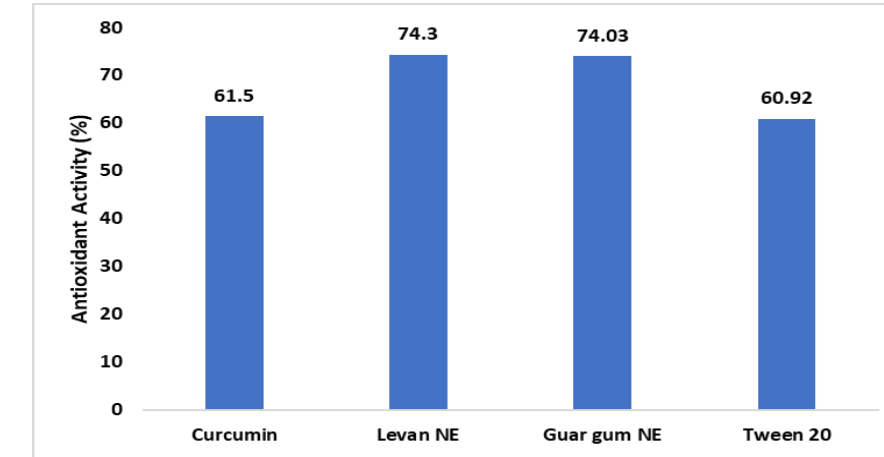
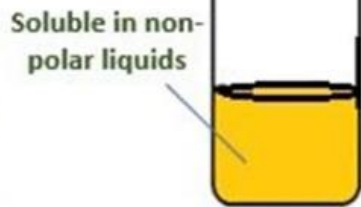


About the technology - Ability of curcumin to scavenge reactive oxygen species (Proxy for bioabsorption)



CURCUMIN

A prominent bioactive compound



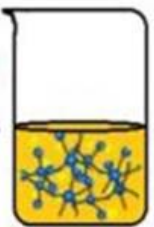
Previous studies

Synthetic Emulsifiers



- Less stability
- Masks antioxidant activity

Current study
Natural polysaccharides



- Small particle size
- Better stability
- Enhanced antioxidant activity



NANOEMULSION

Polysaccharide based nanoemulsion for curcumin delivery.

- Biologically safe, biodegradable Curcumin loaded nanoemulsions without co-emulsifier
- Smaller particle size with natural polysaccharides, used for entrapment of curcumin
- Stable under wide range of physical conditions
- Synergistic increase in the antioxidant potential
- The antioxidant activity of curcumin increased by 15% after its nanoformulation using polysaccharide as emulsifier
- On the other hand, Tween 20 (tw), a synthetic emulsifier used in industries reduces the antioxidant activity of curcumin

Current status

Technology status:

- Technological platform for stable curcumin loaded nanoemulsion using various polysaccharides as emulsifiers. (Demonstrated at lab scale and *in vitro* simulated conditions)
- The study, first of its kind, was able to evaluate efficiency of different polysaccharides for emulsification of curcumin, without the use of any coemulsifier.

Publications

S.no.	Manuscript Title	Journal Name	Year
1	Stimuli-Responsive Polysaccharide-Based Smart Hydrogels and Their Emerging Applications	ACS Industrial & Engineering Chemistry Research	2022
2	Enhanced encapsulation efficiency and controlled release of co-encapsulated <i>Bacillus coagulans</i> spores and vitamin B9 in gellan/ κ -carrageenan/chitosan tri-composite hydrogel	International journal of biological macromolecules	2022
3	Microbial Polysaccharide-Based Nanoformulations for Nutraceutical Delivery	ACS Omega	2022
4	Encapsulated probiotic spores as a fortification strategy for development of novel functional beverages	Innovative Food Science & Emerging Technologies	2022
5	Isolation of an exopolysaccharide from a novel marine bacterium <i>Neorhizobium urealyticum</i> sp. nov. and its utilization in nanoemulsion formation for encapsulation and stabilization of astaxanthin	LWT Food Science and Technology	2021
6	Recent advances in composite hydrogels prepared solely from polysaccharides	Colloids and Surfaces B: Biointerfaces	2021
7	Synthesis and rheological characterization of a novel shear thinning levan gellan hydrogel	International journal of biological macromolecules	2020
8	pH mediated rheological modulation of chitosan hydrogels	International journal of biological macromolecules	2020
9	Exploration of polysaccharide based nanoemulsions for stabilization and entrapment of curcumin	International journal of biological macromolecules	2020
10	Understanding the rheology of novel guar-gellan gum composite hydrogels	Materials Letters	2020
11	Synthesis of a novel gellan-pullulan nanogel and its application in adsorption of cationic dye from aqueous medium	Carbohydrate Polymers	2020

Organization CSIR-IMTECH Industrial Collaboration: Recent clientele



CSIR-Institute of Microbial Technology (IMTech)

National laboratory fore-runner in the domain of microbial biotechnology .

Mission: Address unmet healthcare and industrial needs with state-of-the-art processes and platforms

Expertise in the areas of:

- Bioprocess and fermentation technology,
- Cloning, expression and scale up of recombinant / engineered proteins
- Molecular microbiology, Immunology of infectious diseases,
- Yeast Genetics,
- Screening of microorganisms for novel enzymatic activities and strain improvement,
- Bioinformatics & high end computational biology,
- Microbial taxonomy and metagenomics.



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Team



Dr. Anirban Roy Choudhury
Senior Principal Scientist
CSIR-IMTECH, Chandigarh



Mr. Manuj Tripathi
Senior Scientist
CSIR-IMTECH, Chandigarh



Ms. Nandita Srivastava
Research Scholar
CSIR-IMTECH, Chandigarh



Ms. Richa
Project Assistant
CSIR-IMTECH, Chandigarh



- Expertise in Bioprocess Development and Scale up, Fermentative production of polysaccharides, Polysaccharide based biomaterials.
- More than 2 decades of experience in the industry and academia.
- **Successfully delivered projects to industries like Panacea Biotech, IFB Agro, Excel Biotech, Dhampur Sugar Mill and many more.**

CSIR-Institute of Microbial Technology (IMTech) National laboratory fore-runner in the domain of microbial biotechnology

Key assets and strengths of the team:

- ◆ **35+** publications in bioprocess development and microbial technology.
- ◆ Fermentative production of commercially important biomolecules special interest novel exopolysaccharides for diverse industrial sectors.
- ◆ Development of economically feasible bioprocess for production of Pullulan optimized for 500L fermenter.
- ◆ Application development of polysaccharide-based materials like hydrogels focusing towards food sectors.

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Next Steps



- The team has developed polysaccharide based nanoemulsion (P-NE) encapsulating curcumin.
- The process has been demonstrated at lab scale.
- The next steps are to identify an industrial partner for co-development of the technology involving process optimization, develop purification methods, scale up to pre-commercial levels, carry out detailed testing and produce trial quantities for customer inputs.

Seeking:

- Industrial partners interested in technology licensing
- Industrial partners interested in sponsoring further technology advancement and scale-up
- Industrial partners interested in raising 3rd party funds for a collaborative project
- Industry interested in tapping scientist capabilities as an expert/consultant

For more information, contact:

Kavita Parekh
kavita.parekh@venturecenter.co.in
+91-8956-457042

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References > Market data

1. Saqib et al., 2022 Hydrogel beads for designing future foods:
<https://www.sciencedirect.com/science/article/pii/S2667025922000206>
2. <https://www.databridgemarketresearch.com/reports/global-nanoencapsulation-market>
3. [\(Shishir et al., 2018\)](#)
4. [\(Pires et al., 2022\)](#)
5. [Jiang et al., 2020\)](#)