

Dr. Elena Poverenov

New active materials based on nature-sourced polysaccharides

Dr. Elena Poverenov

Head of the Agro-Nanotechnology and Advanced Materials Research Center

Agricultural Research Organization, Volcani Institute

Tel: 972-50-6220070. e-mail: elenap@volcani.agri.gov.il

webpage: <http://www.agri.gov.il/en/people/1024.aspx>

Polysaccharides as advanced materials for agriculture

Nature-sourced polysaccharide biopolymers hold great promise

- Safe
- Biocompatible
- Non-expensive
- Highly available
- Inexhaustible
- Have well-defined structure

Modified natural polysaccharides as biocompatible delivery systems

Plant nutrients



Drug delivery

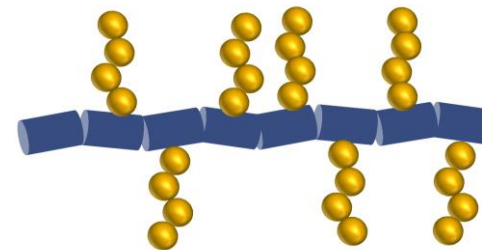
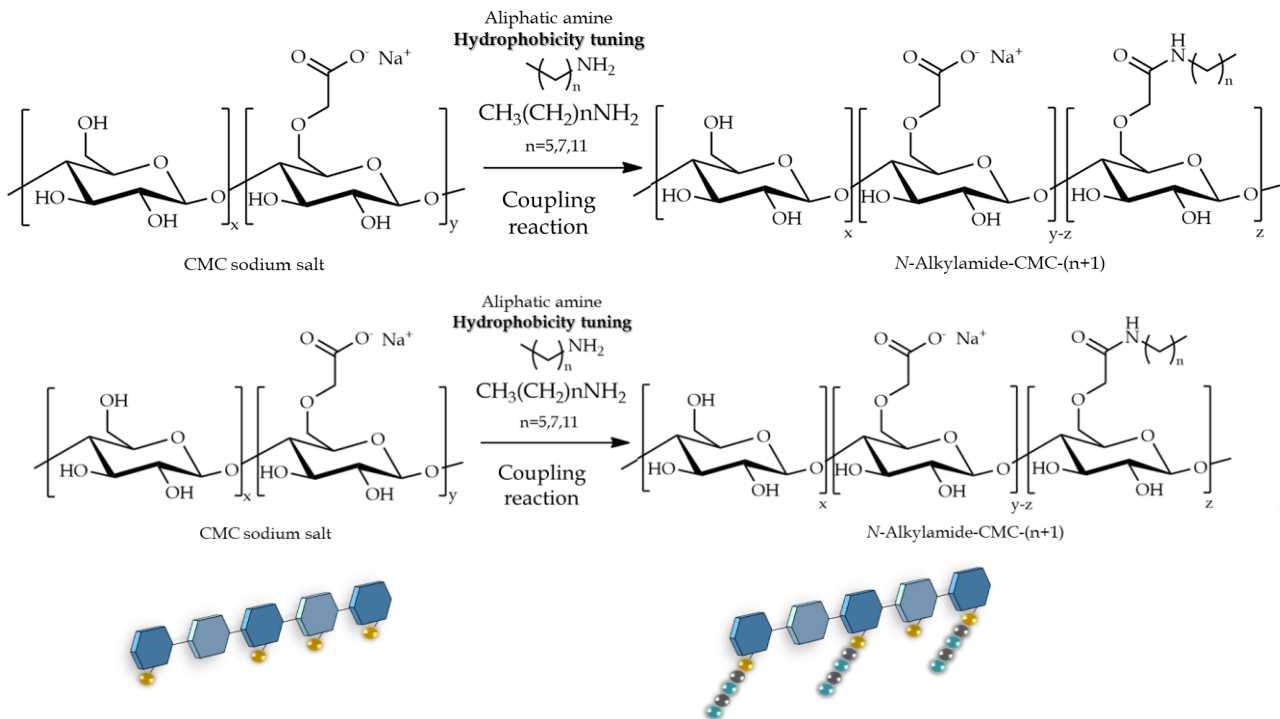


Food Protection

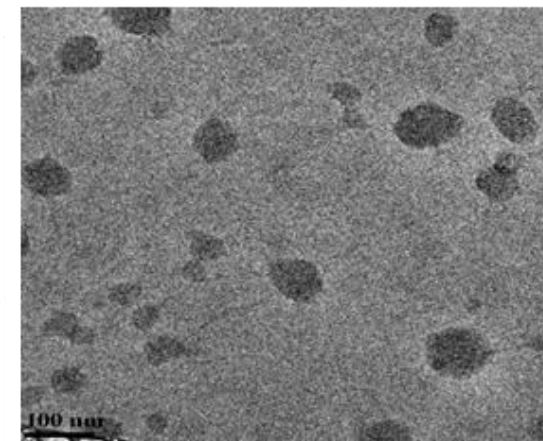
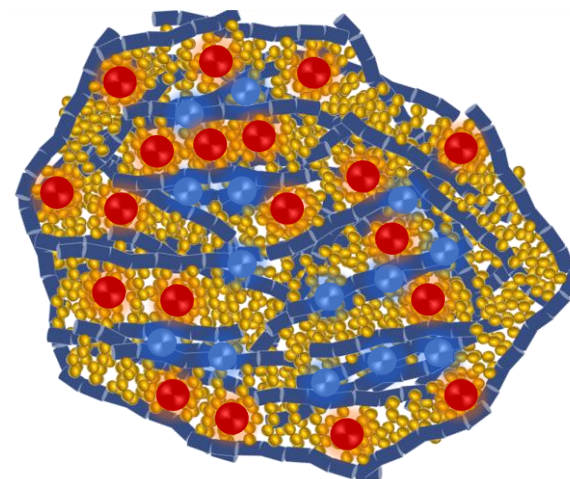
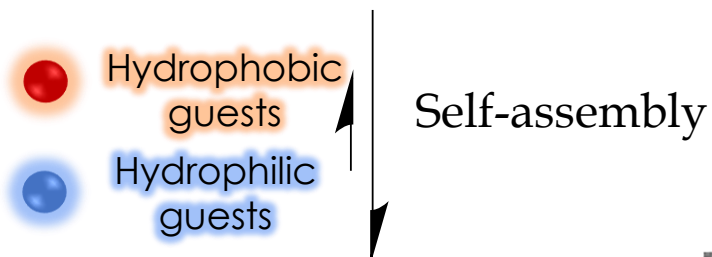


Modifications to induce self-assembling

Modified polysaccharides

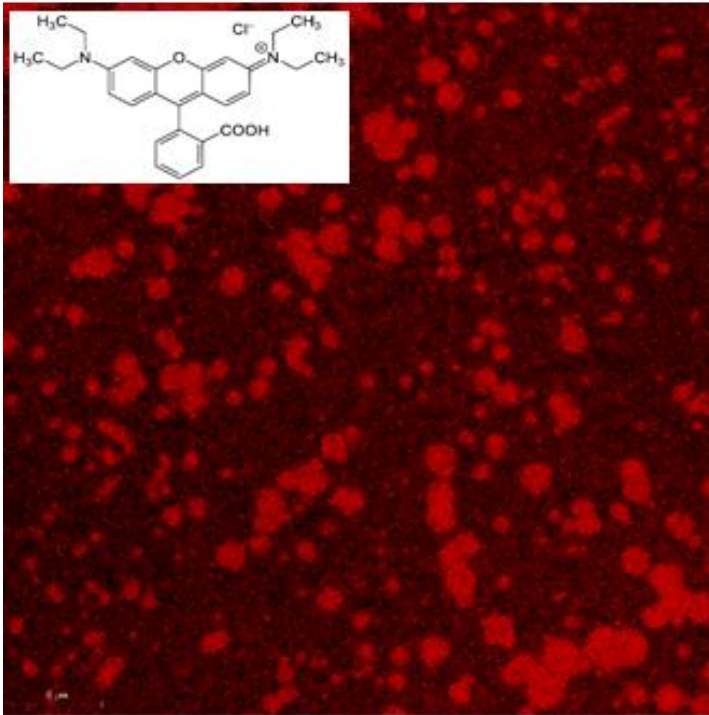


Hydrophilic-Hydrophobic

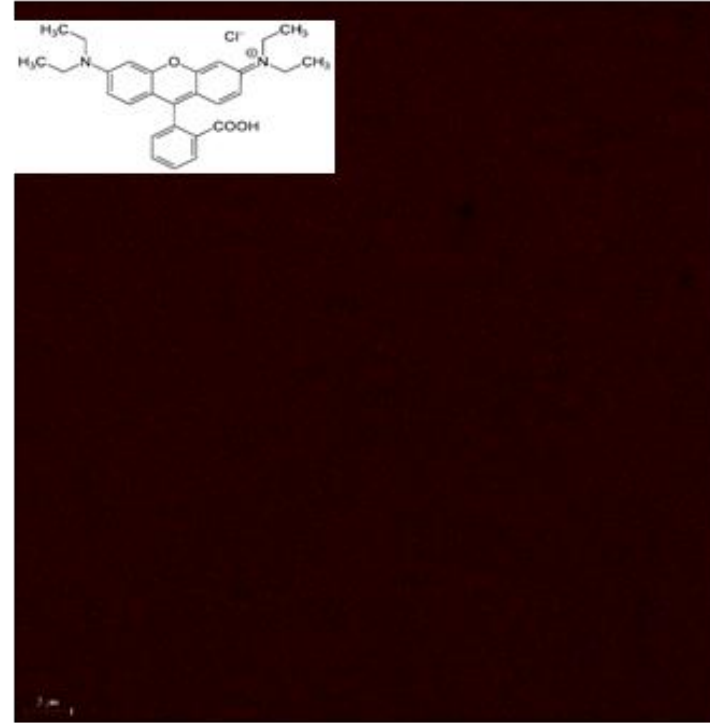


Hydrophilic compound (Rhodamine B) in oil

With our systems

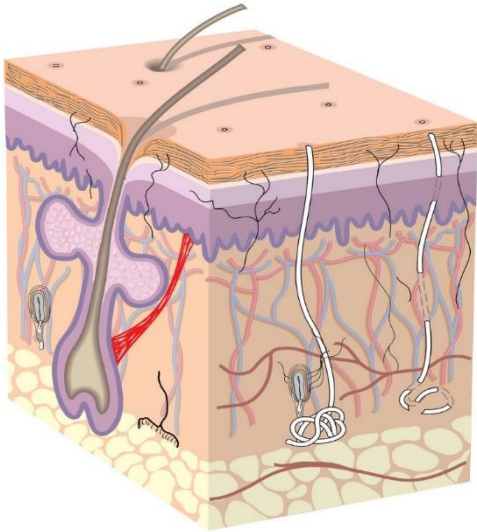


Without our systems

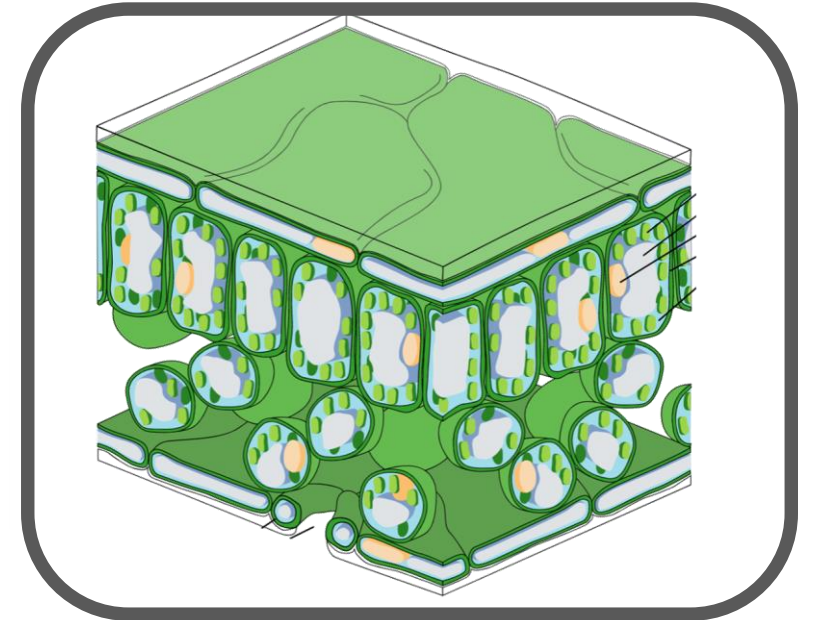


Dynamic structure adaptation to different environments

Skin



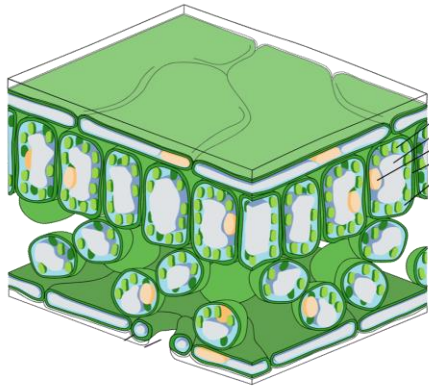
Cuticle



Foliar plant nutrition

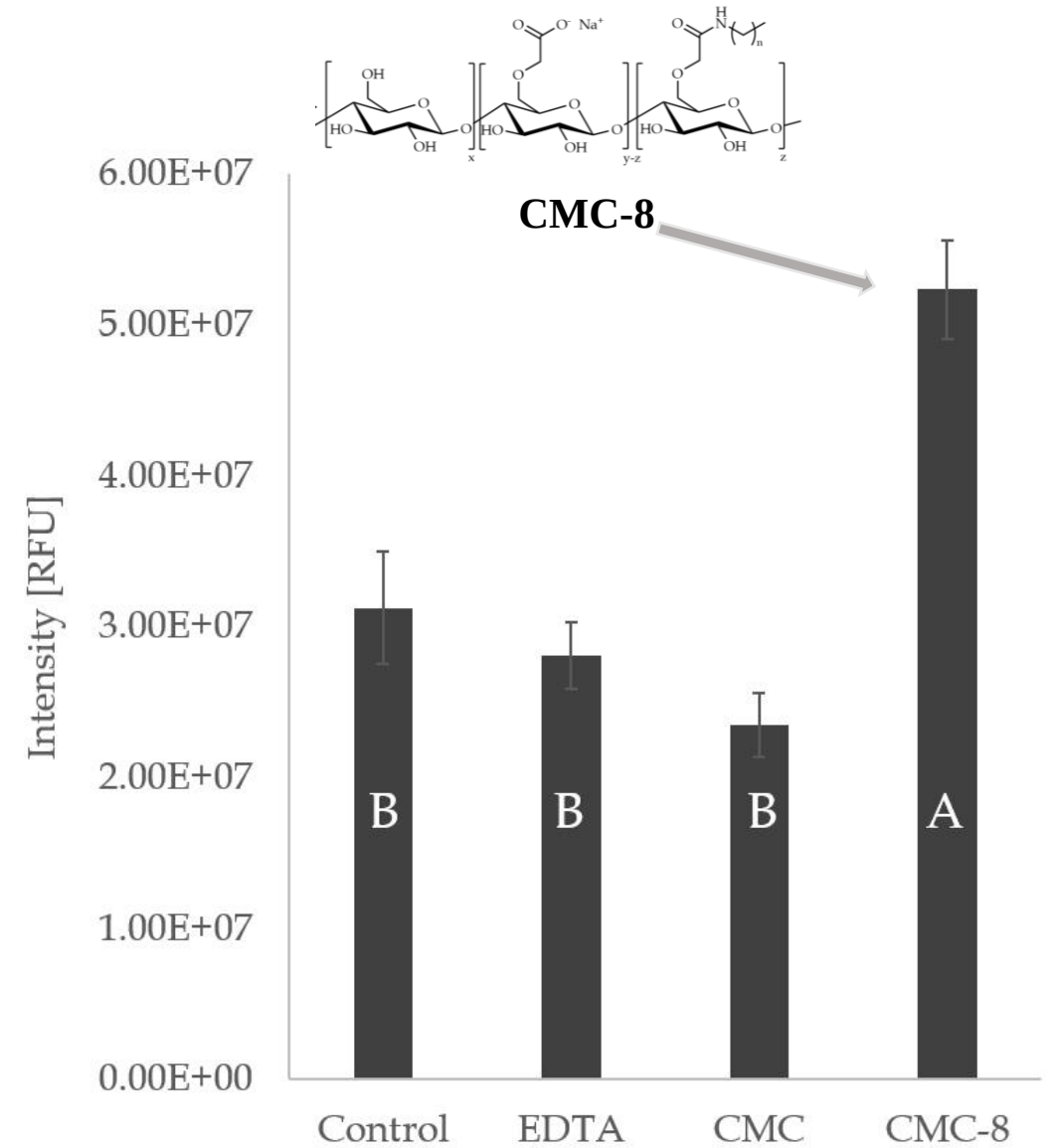
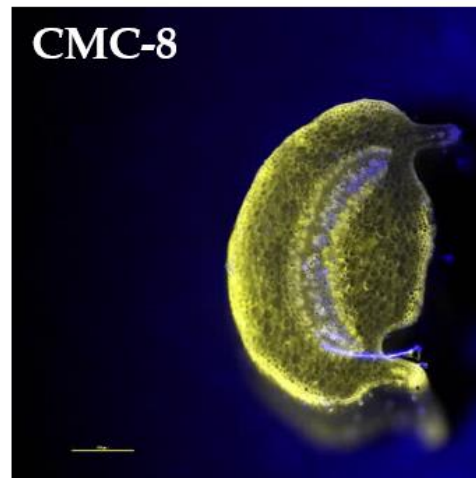
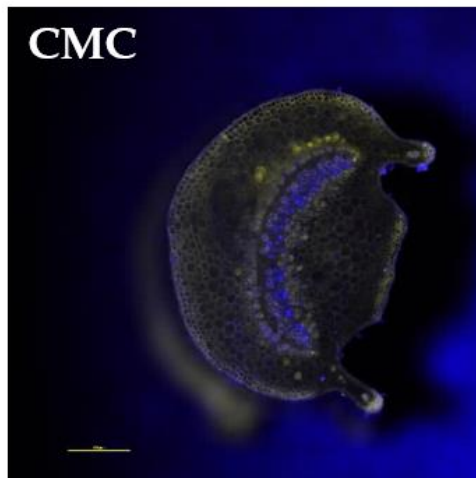
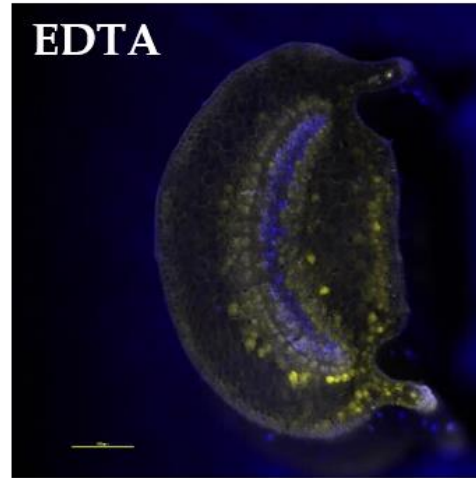
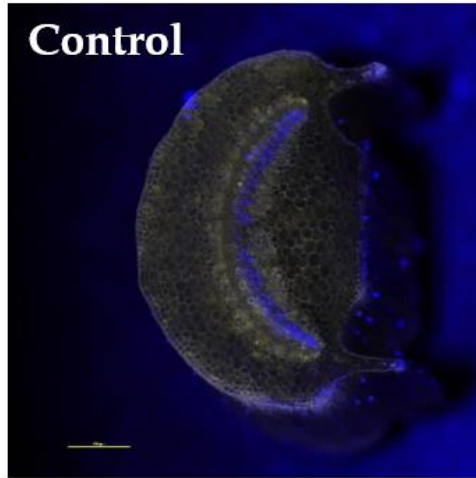
One of the most desired and difficult tasks in modern agriculture

Trans-cuticle

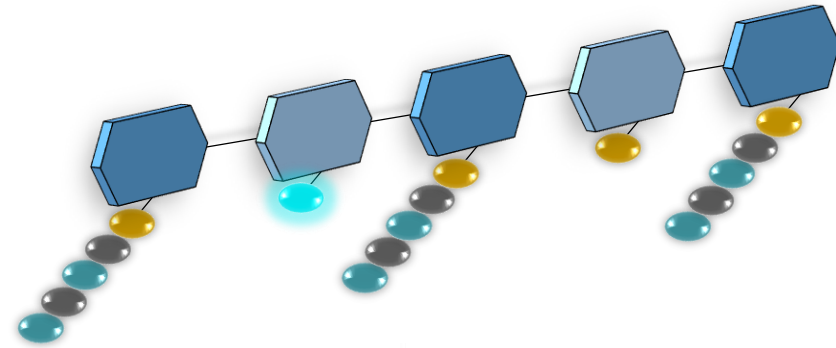
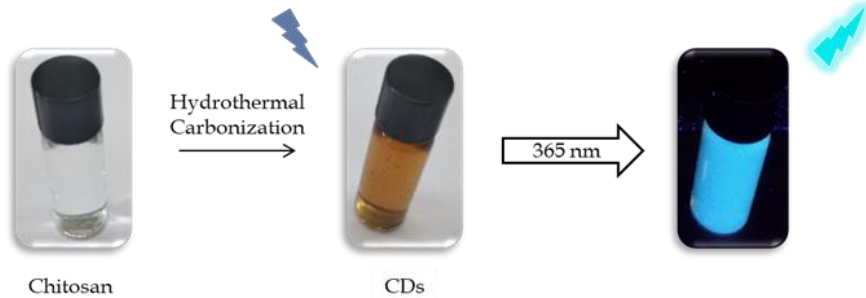
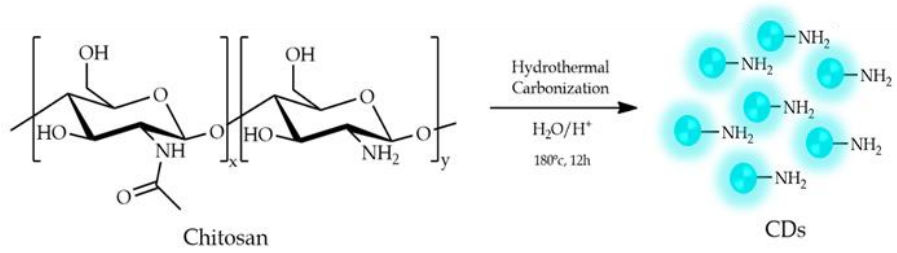


In collaboration with Dr. Hagai Yasuor (Volcani institute)

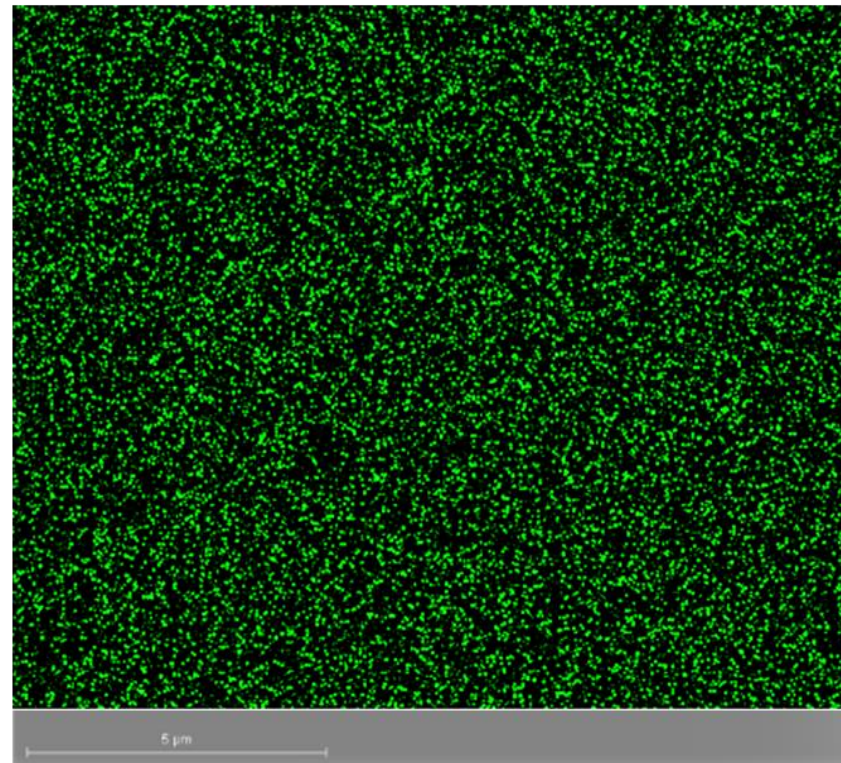
Foliar delivery of Zn microelement



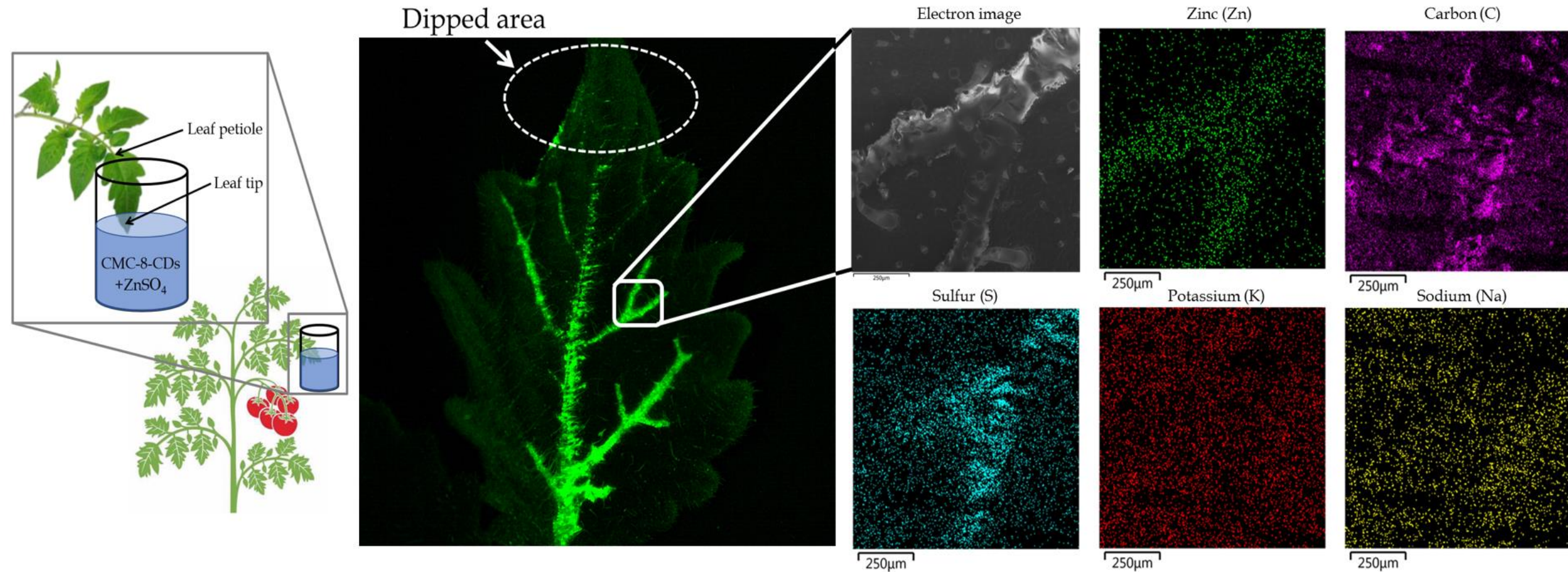
Labeling of CMC-8 with carbon dots (CD)



N-Alkylamide-CMC-8-CDs



Monitoring of CMC-8 carriers and encapsulated Zinc



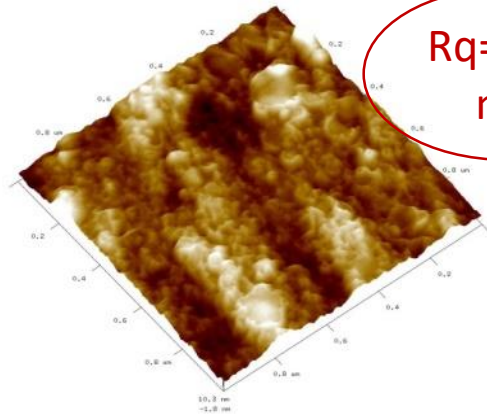
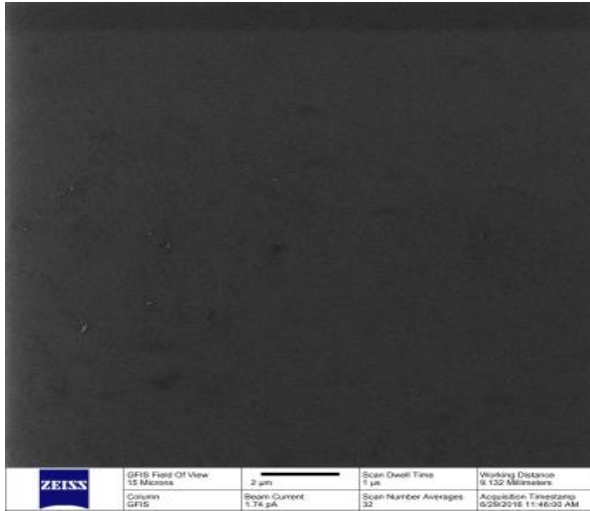
Active biodegradable packages



Improve storability, quality and
safety of food products



In situ deposition of natural bioactive nanoparticles on polysaccharide films

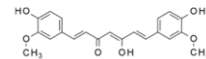


Pristine polysaccharide film

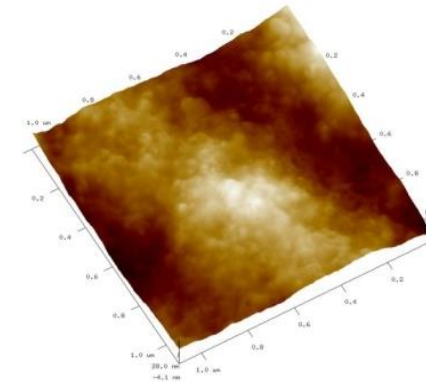
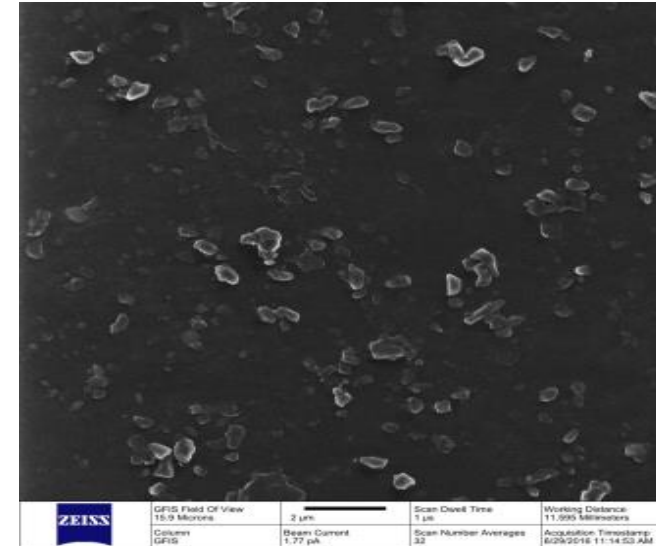
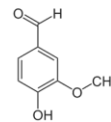
bioactive nanoparticles



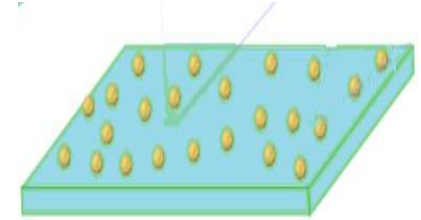
Curcumin



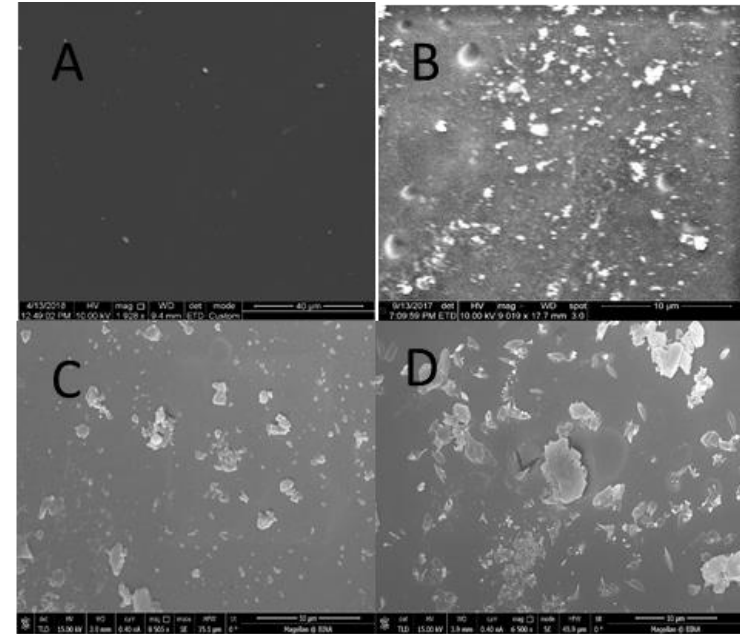
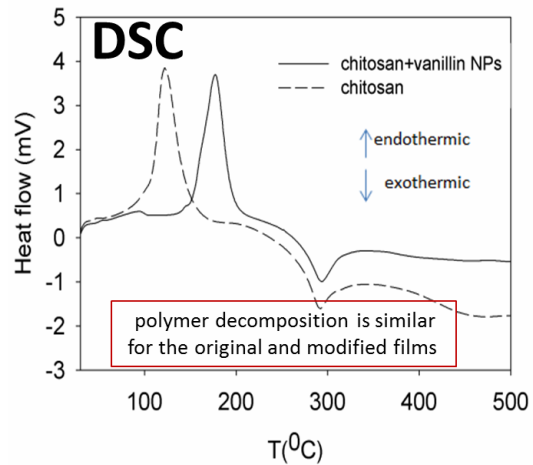
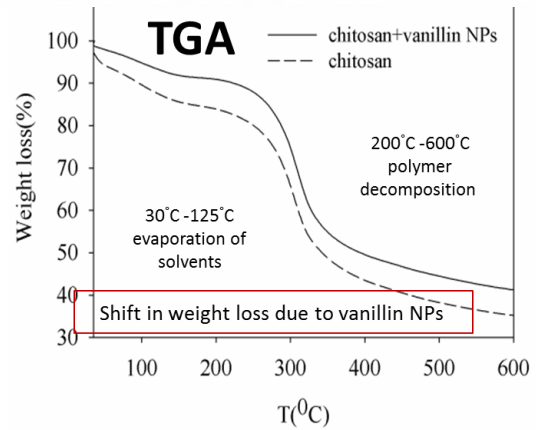
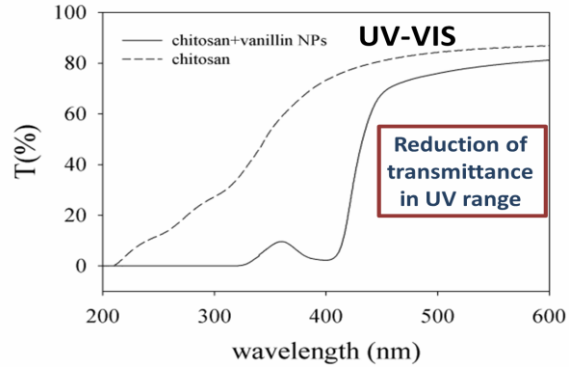
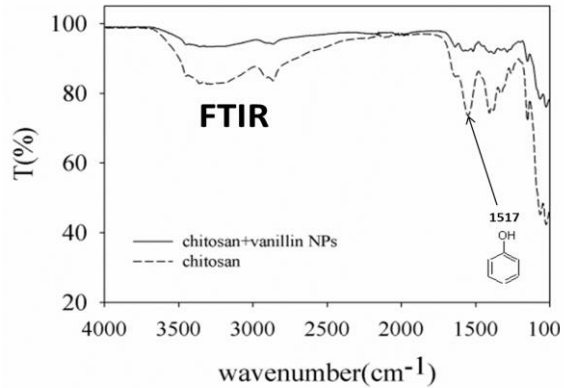
Vanillin



Polysaccharide film grafted with nanoparticles

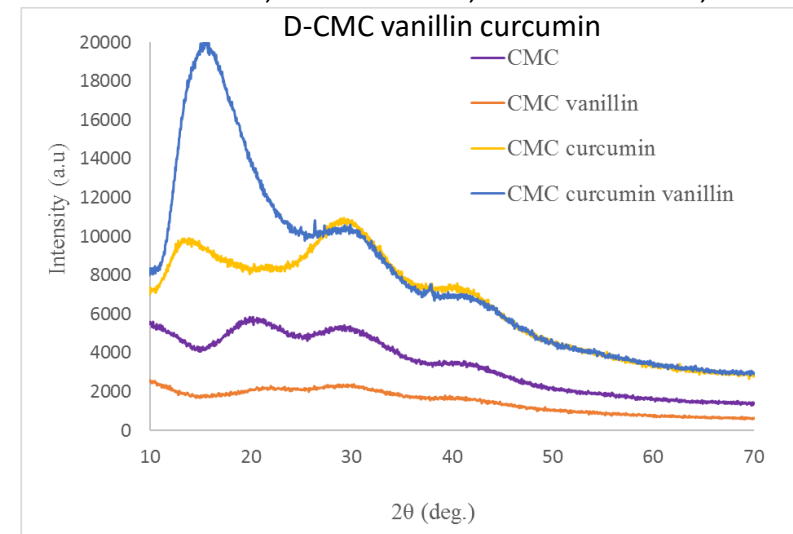


Characterizations

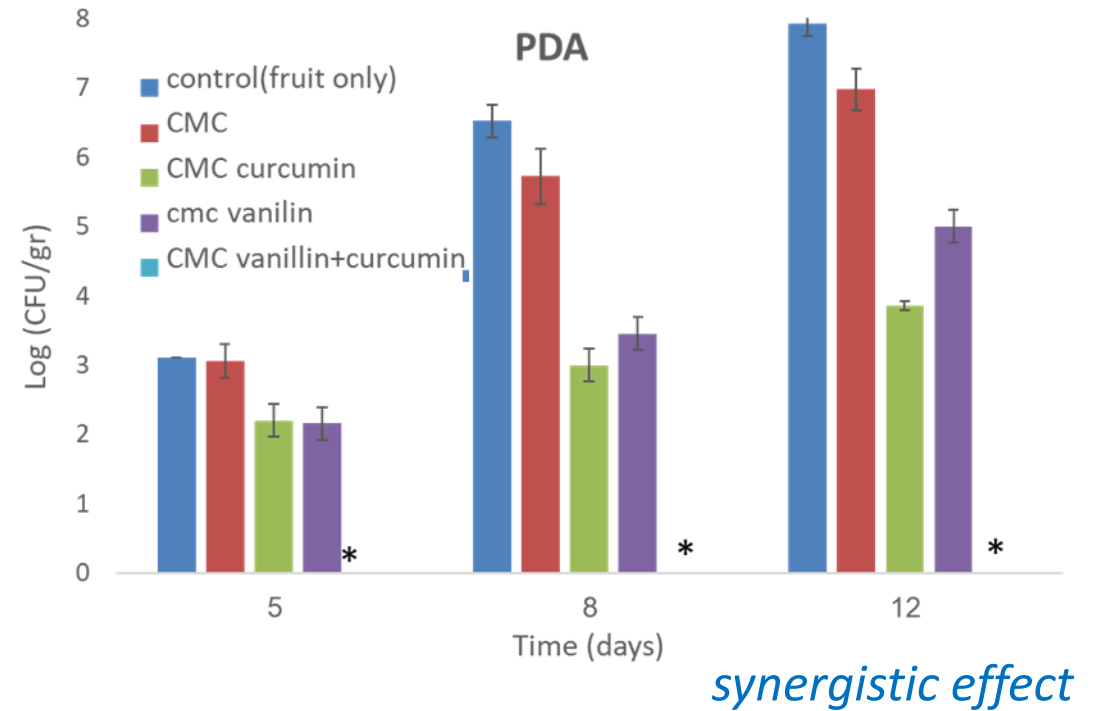
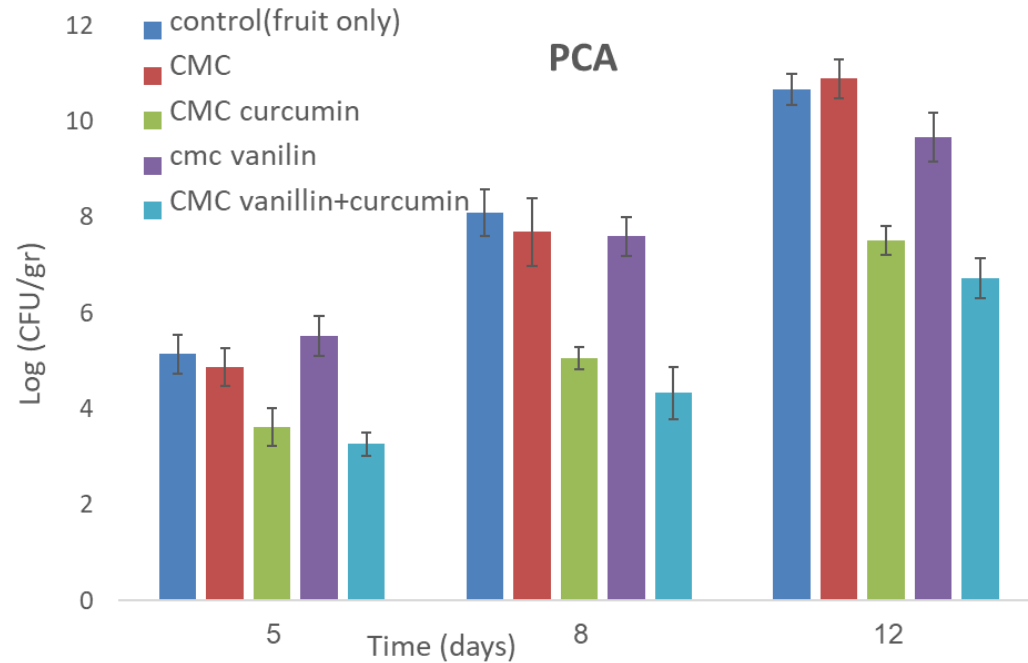


A-CMC, B-CMC vanillin, C-CMC curcumin, D-CMC vanillin curcumin

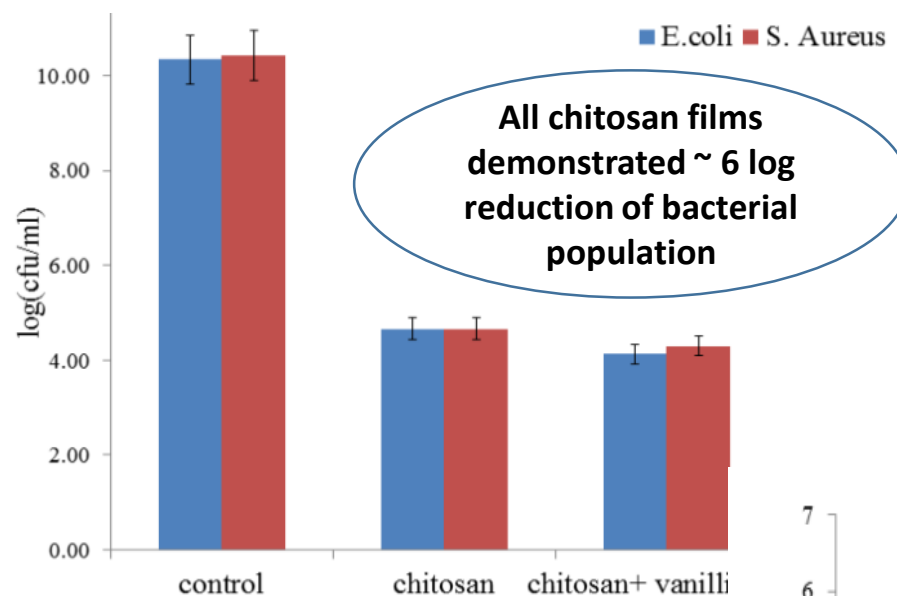
sample	Young Modulus [MPa]	Elongation at break [%]	Max Tensile stress [MPa]	WVP [$\text{g}^*\text{mm}/\text{kPa}^*\text{h}^*\text{m}^2$]
chitosan	1204.75±309.65	25.63±4.97	6.51±3.12	0.51±0.13
chitosan +vanillin NPs	1412.10±406.1	24.25±2.43	24.24±18.33	0.29±0.01



Antimicrobial protection carboxymethyl cellulose-based films with vanillin and curcumin

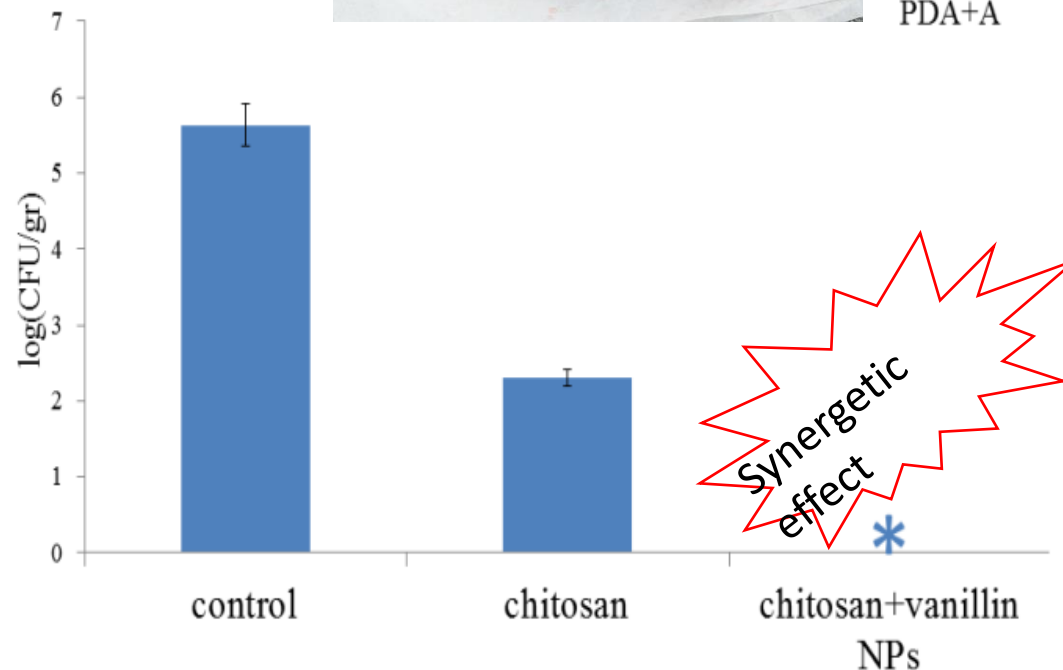


Antimicrobial protection chitosan-based films with vanillin



PDA+A

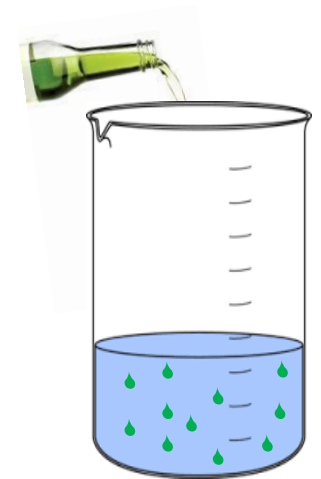
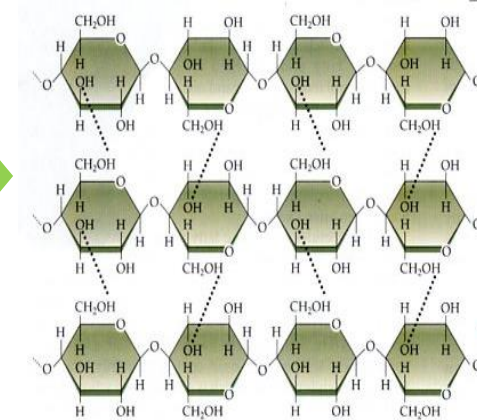
Chitosan+vanillin NPs films resulted in total inhibition of yeast and fungal growth



Active edible coatings



Postharvest protection of agricultural products



Active edible coatings

1) Prolong shelf-life

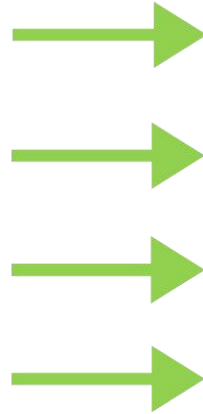
2) Improve quality and safety

- to reduce microbial spoilage
- to reduce moisture loss

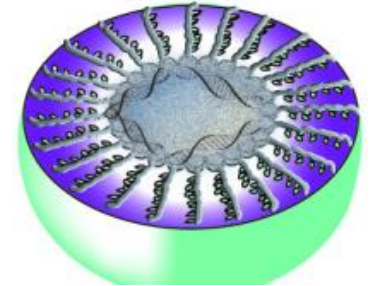
3) Enhance attractiveness

- color, gloss, aroma

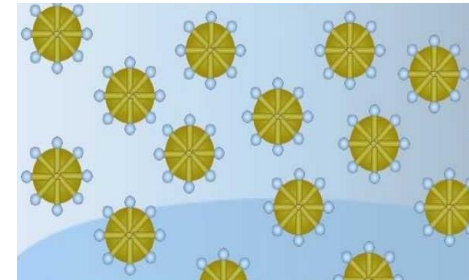
Delivery matrix



nanocarriers



nanoemulsions



Active edible coatings protection of agricultural products



Active edible coatings protection of agricultural products



active coatings



control



Active edible coatings protection of agricultural products



Summary

Biopolymers-based nanomaterials materials can be used in agriculture as

(1) Advanced delivery systems for

- foliar nutrition
- food protection
- medicine delivery

(2) Active biodegradable packages

(3) Edible Coatings

Collaborations

Prof. Petr Král University of Illinois, Chicago
Prof. Philip Demokritou [Harvard University]
Prof. Tara McHugh (USDA)
Prof. Eldad Silberstein [BGU]
Prof. Moshe Sagi [BGU]
Prof. Udi Banin (BIU)
Prof. Aharon Gedanken (BIU)
Prof. Udi Banin
Prof. Oded Shoseyov (HUJ)
Prof. Dganit Danino (Technion)
Prof. Robert Fluhr [WIS]
Dr. Guy Cohen [dead sea & arava science center - BGU]
Dr. Dmitry Tworowski [WIS]
Dr. Hagai Yasuor [Volcani Institute, Gilat Center - ARO]
Dr. Evgeni Eltzov [Volcani Institute – ARO]
Dr. Maya Kleiman [Volcani Institute – ARO]
Dr. Victor Rodov [Volcani Institute – ARO]
Dr. Anat Elman [Volcani Institute – ARO]
Dr. Noam Alkan [Volcani Institute – ARO]
Dr. Ziv Spiegelman [Volcani Institute – ARO]
Dr. Ron Porat [Volcani Institute – ARO]
Dr. Elazar Fallik [Volcani Institute – ARO]
Dr. Dani Eshel [Volcani Institute – ARO]
Prof. Shlomo Sela [Volcani Institute – ARO]
Dr. Hinanit Koltai [Volcani Institute – ARO]
Prof. Samir Drobi [Volcani Institute – ARO]

Former group members

Dr. Roi Rutenberg
Dr. Anat Phylosoff

Dr. Hadar Arnon
Lilah Saidi

Group members

Dr. Sateesh Sagiri
Dr. Imanaliev Ainur
Dr. Alexander Laskavy
Dr. Erez Cohen

Rafael Izhakov
Adi Semo
Yevgenia Shebes
Tal Klingbell

Dr. Miri Klein
Dr. Stella Kiel

Dr. Ilya Shlar
Aviva Buslovich

Noa Shkuri
Aviad Sela

Acknowledgments



BARD



Ministry of Agriculture and
Rural Development



יק"א בישראל
ICA in Israel
JCA Charitable Foundation



MINISTRY
OF HEALTH
For a healthier life



Israel Ministry of
Science & Technology
משרד המדע והטכנולוגיה

רשות החדשנות
Israel Innovation
Authority



Thank You

Dr. Elena Poverenov

Head of Agro-nanotechnology and Advanced Materials Research Center

Agricultural Research Organization, Volcani Institute

Tel: 972-50-6220070 e-mail: elenap@volcani.agri.gov.il

webpage: <http://www.agri.gov.il/en/people/1024.aspx>