PhD in Agri-Food Sciences, Technologies and Biotechnologies - UNIMORE

XXXIV CYCLE: III year

Investigation and development of innovative protocols and technologies to enhance food safety and to reduce food loss

Annual Workshop: December 17th 2021

PhD student: **Francesco Bigi**

Tutor: **Prof. Dr. Andrea Pulvirenti**

PhD STEBA School Co-ordinator:
Prof. Dr. Alessandro Ulrici

PROBLEMS

88 million

TONES FOOD WASTED/YEAR
IN EUROPE

173 kg/year
per person

25.8 million

TONES PLASTIC PACKAGING/YEAR
IN EUROPE

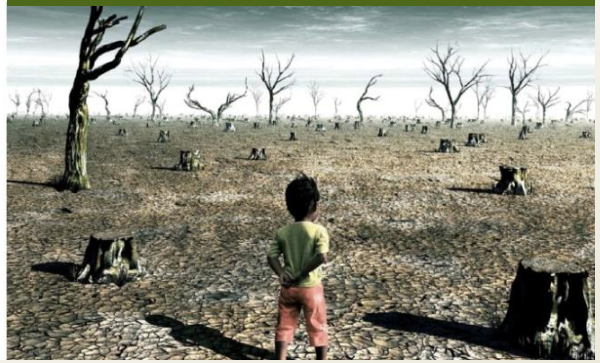
less than 30%
recycled

CONSEQUENCES OF FOOD AND PLASTIC WASTE

FOOD LOSS

HUNGER

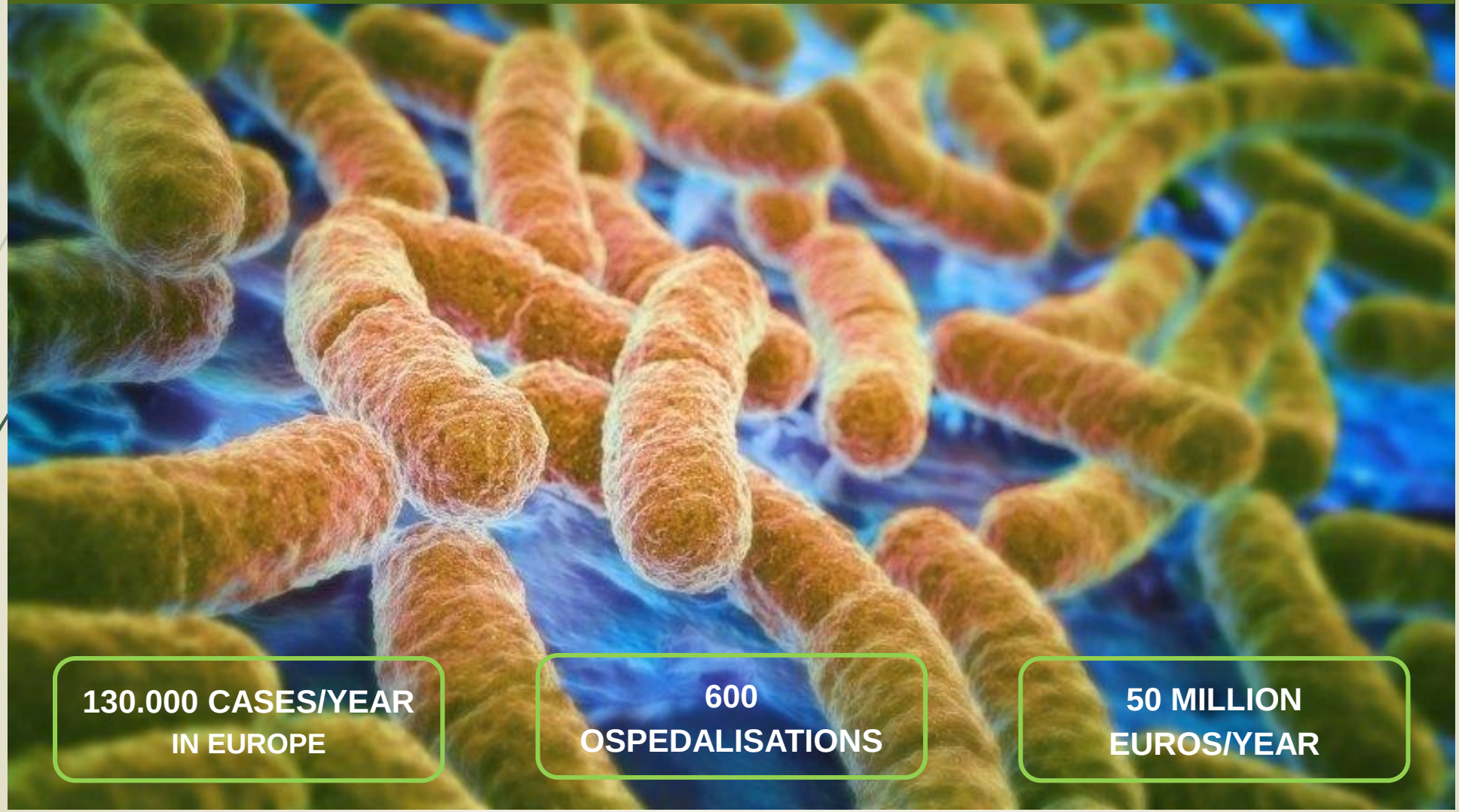
ENVIRONMENTAL DAMAGE



POLLUTION

PROBLEMS

FOOD SAFETY



SOLUTIONS

PRODUCT INNOVATION

PROCESS INNOVATION

BIO-ACTIVE PACKAGING

CASE STUDY 1

Received: 5 November 2020 | Revised: 28 January 2021 | Accepted: 7 February 2021

DOI: 10.1111/jfs.12892

ORIGINAL ARTICLE

Journal of Food Safety WILEY

Impact of low-dose gaseous ozone treatment to reduce the growth of in vitro broth cultures of foodborne pathogenic/spoilage bacteria in a food storage cold chamber

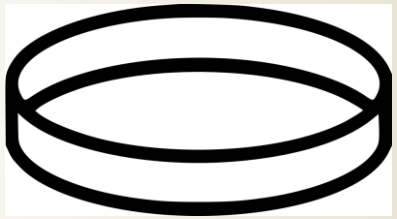
Francesco Bigi[1] | Hossein Haghighi[1] | Andrea Quartieri[1] | Riccardo De Leo[1] | Andrea Pulvirenti[1,2]

https://doi.org/10.1111/jfs.12892

CONDITIONS

3°C

Gaseous ozone (0.05 ppm)



Different treatment times

CONDITIONS

- ✓ **Microbial quality of air and internal surfaces**
- ✓ **2 treatment times** (30 and 60 min)

- ✓ **Five food-borne pathogens** (*C. jejuni*, *S. Thyphi.*, *E. coli*, *L. monocyt.*, *P. fluorescens*)
- ✓ **3 concentrations of inoculum**
- ✓ **6 treatment times** (1, 2, 6, 24, 30, 48 h)

RESULTS

Bacterial loads	Control	Ozone treatment (30 min)	Ozone treatment (60 min)
Internal surfaces (log_{10} CFU/m^2)	3.60 ± 3.18^{b}	2.61 ± 2.23^{a}	2.28 ± 2.02^{a}
Air (log_{10} CFU/m^3)	1.81 ± 1.27^{b}	0.90 ± 0.60^{a}	0^{*}

Bacterial strains (log10 CFU/plate)	Control	Ozone treatment at 0.05 ppm					
		1 hr	2 hr	6 hr	24 hr	30 hr	48 hr
C. jejuni	3.34 ± 1.86^{b}	1.11 ± 0.63^{a}	0	0	–	–	–
	2.35 ± 1.69	0^{*}	0	0	–	–	–
	1.34 ± 0.45	0	0	0	–	–	–
S. enterica	3.30 ± 1.89^{c}	U.C.[†]	U.C.	U.C.	1.69 ± 1.19^{b}	1.06 ± 0.55^{b}	0.15 ± 0.00^{a}
	2.37 ± 1.10^{b}	2.34 ± 1.79^{b}	2.34 ± 1.85^{b}	2.35 ± 1.92^{b}	1.28 ± 0.15^{a}	0.60 ± 0.15^{a}	0
	1.39 ± 0.33^{b}	1.30 ± 0.45^{b}	1.41 ± 1.25^{b}	1.42 ± 0.69^{b}	0.30 ± 0.15^{a}	0.18 ± 0.00^{a}	0
E. coli	3.38 ± 1.72^{b}	U.C.	U.C.	U.C.	1.31 ± 0.33^{a}	1.24 ± 0.33^{a}	1.16 ± 0.33^{a}
	2.37 ± 1.03^{e}	2.32 ± 0.45^{d}	2.10 ± 0.55^{c}	2.01 ± 0.15^{b}	0.60 ± 0.15^{a}	0.48 ± 0.15^{a}	0
	1.38 ± 0.63^{b}	1.00 ± 0.15^{a}	1.04 ± 0.15^{a}	0.90 ± 0.15^{a}	0	0	0
L. monocytogenes	3.34 ± 1.63^{b}	U.C.	U.C.	U.C.	1.39 ± 0.33^{a}	1.20 ± 0.15^{a}	1.04 ± 0.45^{a}
	2.32 ± 1.19^{c}	2.29 ± 1.23^{bc}	2.21 ± 1.28^{b}	2.18 ± 1.56^{ab}	0.60 ± 0.15^{a}	0.18 ± 0.33^{a}	0
	1.38 ± 0.63^{a}	1.26 ± 1.10^{a}	1.27 ± 1.03^{a}	1.00 ± 0.45^{a}	0^{*}	0	0
P. fluorescens	3.32 ± 1.55^{c}	2.12 ± 1.08^{b}	1.70 ± 0.93^{a}	1.63 ± 0.45^{a}	1.61 ± 0.55^{a}	1.54 ± 0.96^{a}	1.45 ± 0.96^{a}
	2.34 ± 1.00^{d}	1.22 ± 0.33^{c}	1.06 ± 0.33^{bc}	0.90 ± 0.15^{ab}	0.60 ± 0.45^{ab}	0.60 ± 0.15^{ab}	0.48 ± 0.15^{a}
	1.28 ± 0.45^{b}	0.30 ± 0.15^{a}	0	0	0	0	0

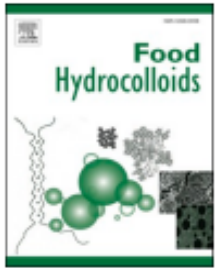
CASE STUDY 2

Food Hydrocolloids 120 (2021) 106979

Contents lists available at ScienceDirect

Food Hydrocolloids

journal homepage: www.elsevier.com/locate/foodhyd



Check for updates

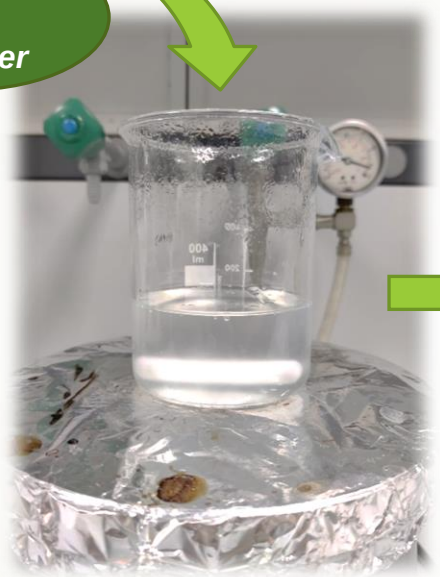
Characterization of chitosan-hydroxypropyl methylcellulose blend films enriched with nettle or sage leaf extract for active food packaging applications

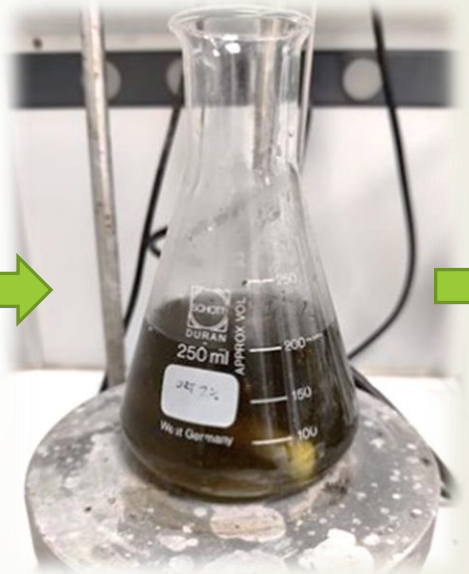
Francesco Bigi [a,1], Hossein Haghighi [a,*,1], Heinz Wilhelm Siesler [b], Fabio Licciardello [a,c], Andrea Pulvirenti [a,c]

https://doi.org/10.1016/j.foodhyd.2021.106979

CONDITIONS

7.5 or 15% w/w polymer



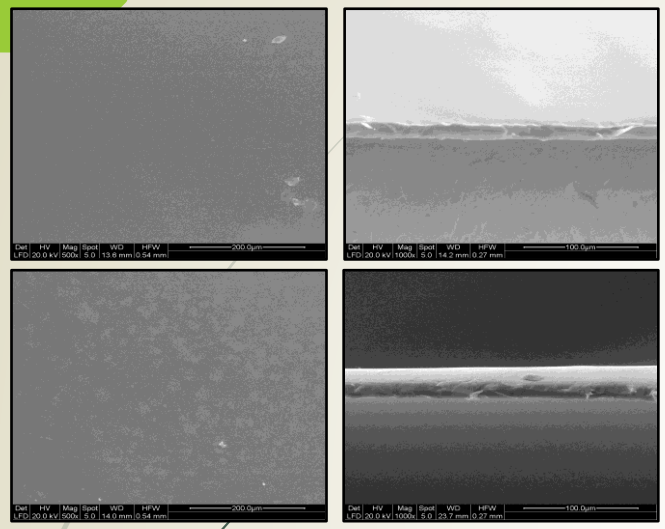


HYDRO-ALCOHOLIC EXTRACT
(ultrasound-assisted extraction)

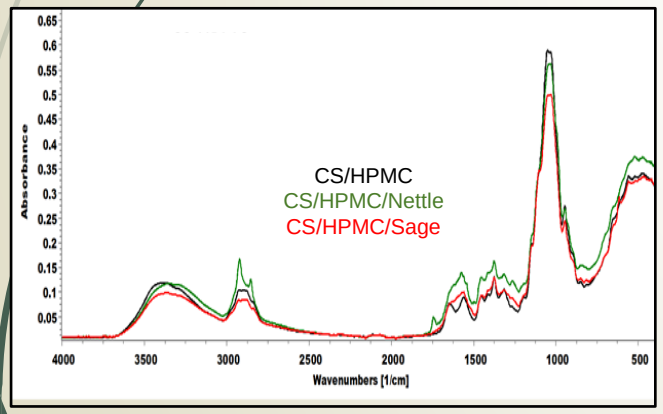
CS-HPMC BLEND
(1,5% w/v)

RESULTS

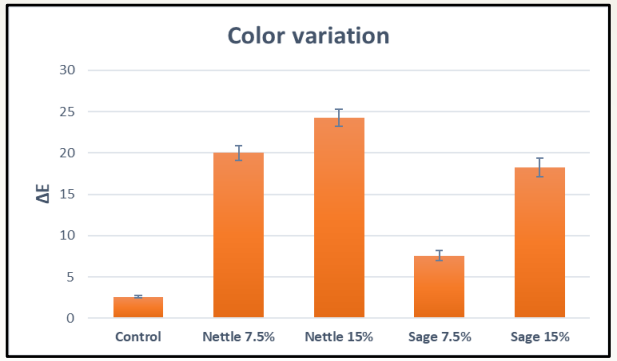
MICROSTRUCTURE

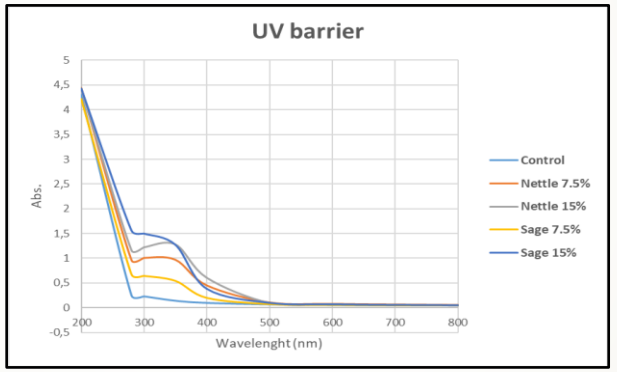


FT-IR SPECTROSCOPY

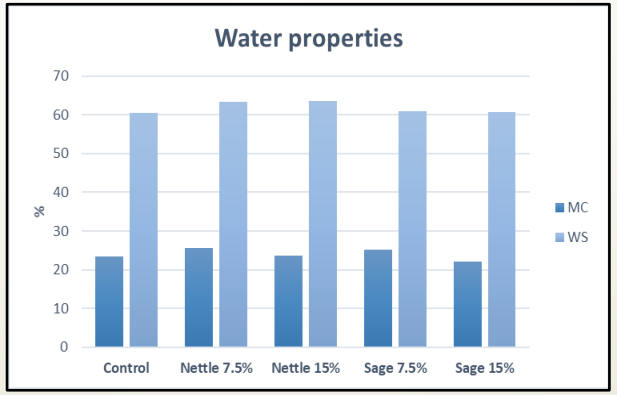


OPTICAL PROPERTIES

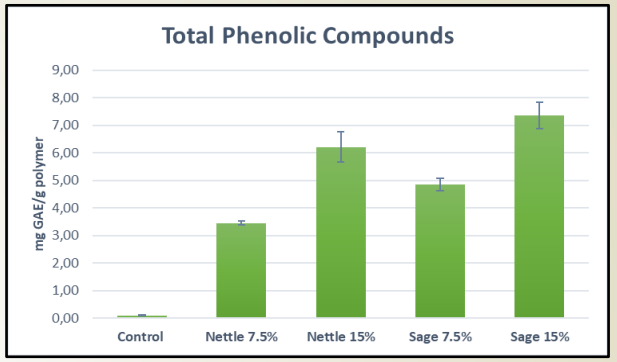


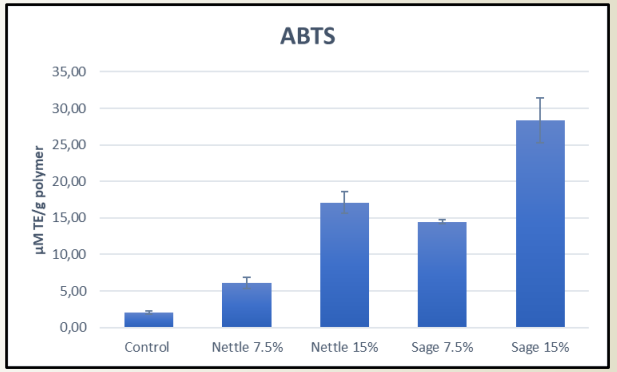


WATER PROPERTIES

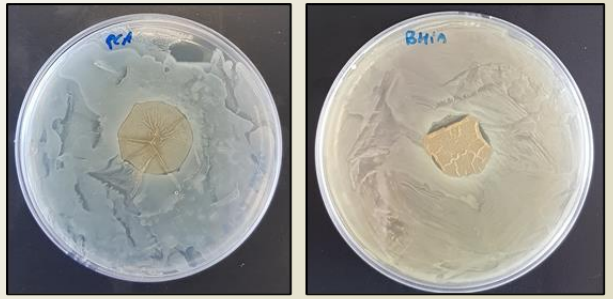


ANTIOXIDANT PROPERTIES





ANTIBACTERIAL ACTIVITY



CASE STUDY 3

Nanocomposite active films based on chitosan/hydroxypropyl methylcellulose blend enriched with orange peel cellulose nanocrystals and lauroyl arginate ethyl as a novel food packaging solution

Francesco Bigi, Enrico Maurizzi, Heinz Wilhelm Siesler, Andrea Pulvirenti , Hossein Haghighi

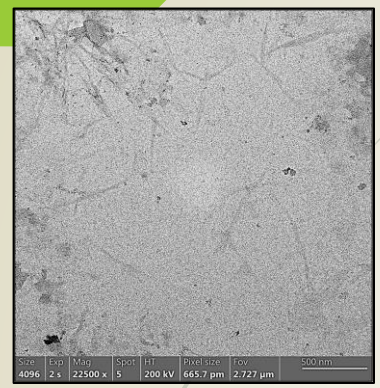
Submitted to: Food Packaging and Shelf Life

CONDITIONS

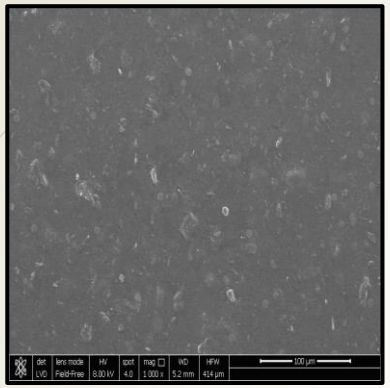

Stabilised Orange Peels
Cellulose Powder
Cellulose Nanocrystals
10% w/w polymer
Lauroyl Arginate Ethyl (LAE)
5% w/w polymer
CS/HPMC Blend (2% w/v)
CS/HPMC/CNCs/LAE

RESULTS

MICROSTRUCTURE

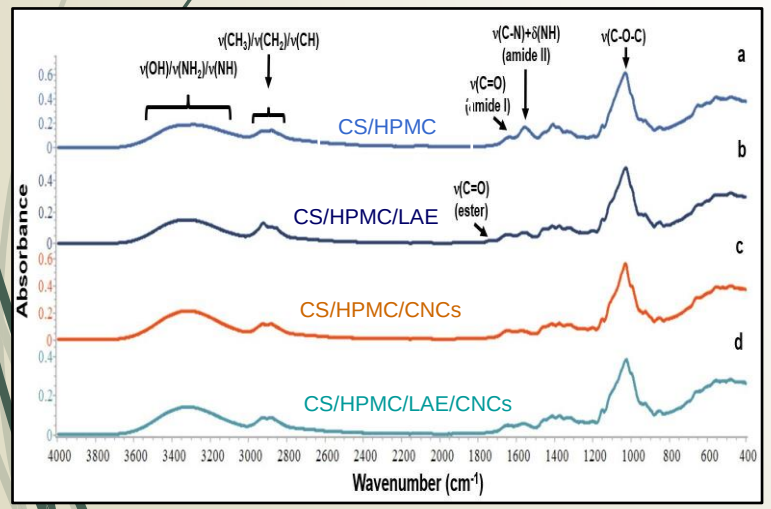


TEM image of orange CNCs

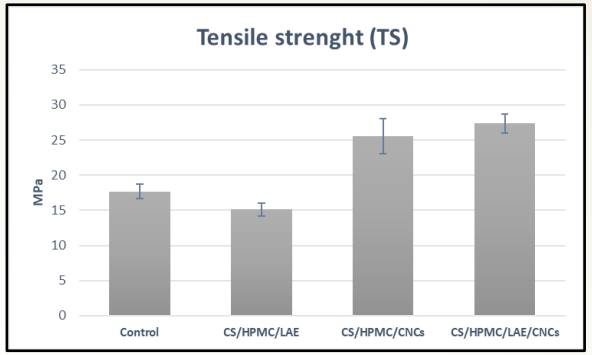


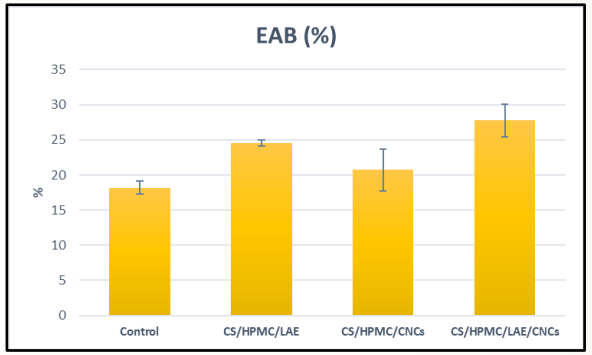
SEM image of CS/HPMC/CNCs/LAE film

FT-IR SPECTROSCOPY

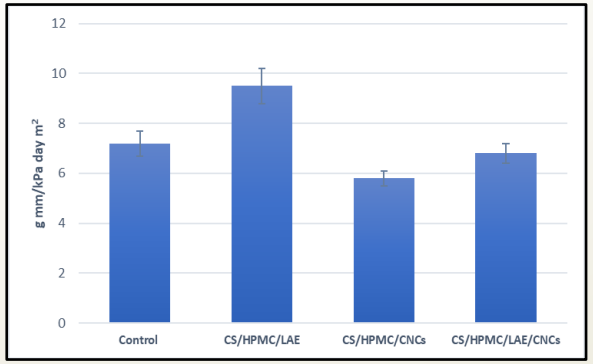


MECHANICAL PROPERTIES

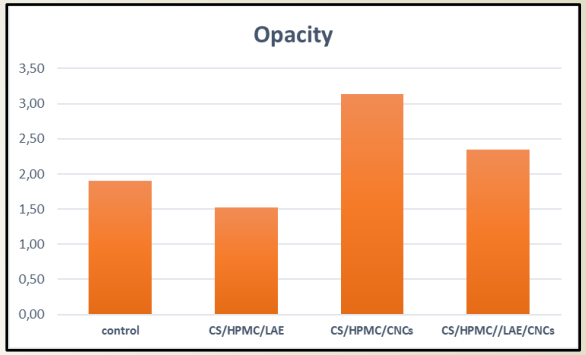




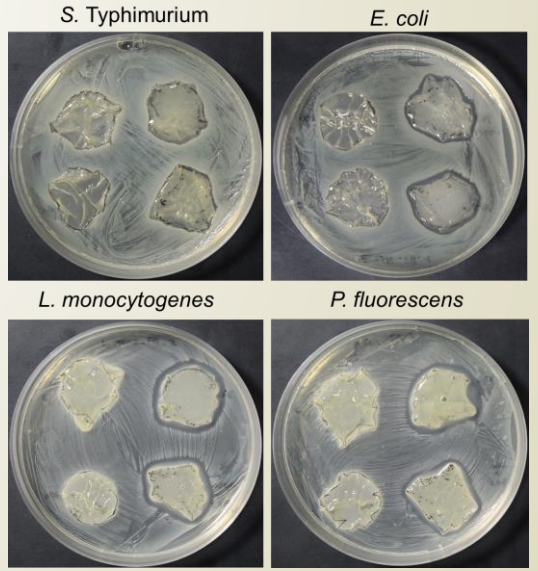
WATER VAPOUR PERMEABILITY



OPTICAL PROPERTIES



ANTIBACTERIAL ACTIVITY



THANKS FOR YOUR ATTENTION!!