



LEADING A REVOLUTION  
IN BIOWASTE RECYCLING

# On the use of Black soldier fly insects as a novel source for the development of sustainable value- added products

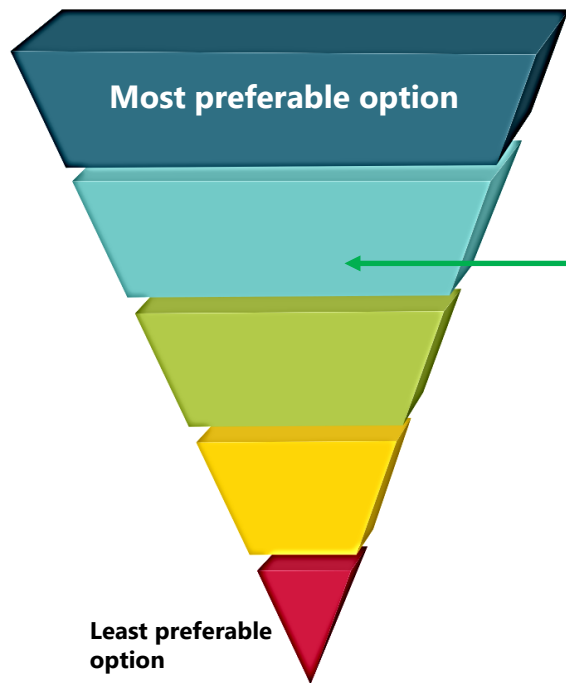
Alejandro Aragón (ITENE)  
Final Meeting - 19 October 2022, Valencia, (Spain)



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# Challenge - Positioning



## Prevent

- Waste of raw materials, ingredients and products arising is reduced — measured in overall reduction in waste

## Re-use

- Redistribution to people
- Sent to animal feed

## Recycle

- Waste sent to anaerobic digestion
- Waste composted

## Recover other value

- Incineration of waste with energy recovery

## Dispose

- Waste incinerated without energy recovery
- Waste sent to landfill
- Waste disposed of in sewerage system

ORGANIC WASTE



INSECTS



PROTEINS, FAT  
and CHITIN

# Challenge - Positioning

UNIMORE

Insects rearing

Zetadec & NS

Fractionation, analyses,  
and protein applications



UNIMORE

Fractionation Process



**UNIMORE**  
UNIVERSITÀ DEGLI STUDI DI  
MODENA E REGGIO EMILIA



ITENE

Chitin and chitosan applications



KOUR ENERGY

Optimization Pilot Plant

**KOUR ENERGY** Srl  
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# Challenge - Positioning

ITENE

Chitin and chitosan applications



About chitin/chitosan...

- Chitin and its derivatives (chitosan) represent a well reviewed **biopolymer** with many beneficial applications (biomedicine, food industry, materials, cosmetics, etc.)
- Main sources: crustaceans (Research on **alternative sources such as insects are still developing**)
- **Second most abundant biopolymer** after cellulose
- Biodegradable, biocompatible and non-toxic

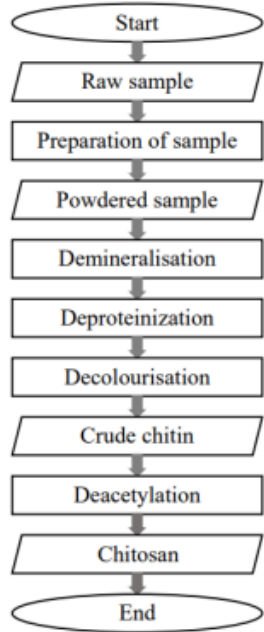
ITENE

Chitin and chitosan applications

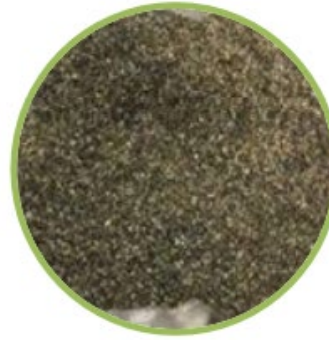


- To develop a chemical-enzymatic method to extract chitin from black soldier fly
- To convert chitin into i) nanofibers and ii) chitosan
- To show the applicability of chitin nanofibers and chitosan in food packaging applications

## ➤ (Brief) Description of the process



Raw sample (BSF)



Powdered sample (<2 mm)

Demineralization  
Deproteinization



Crude chitin

Decolourisation



Chitin sample

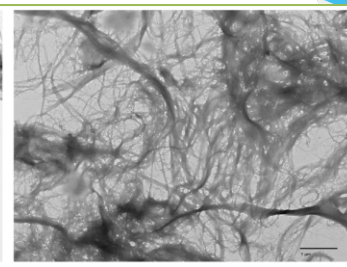
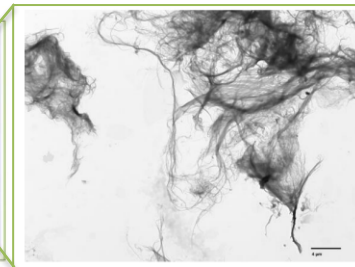
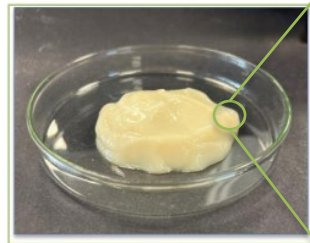


## ➤ (Brief) Description of the process



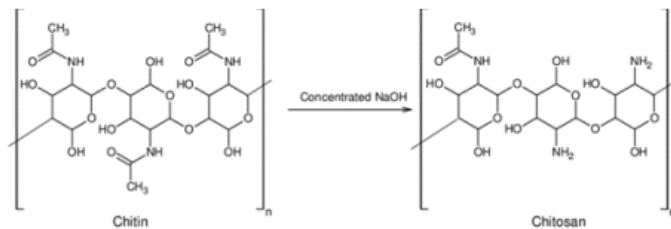
Chitin sample

Development of nanofibers



20 nm width

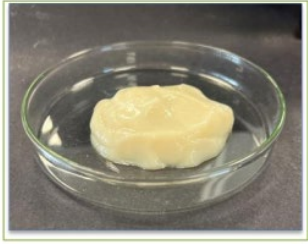
Obtention of chitosan



Powdered chitosan



## ➤ Applications and main results



Chitin nanofibers

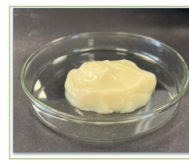
1. Additive in food Packaging materials
2. Ingredient in high oxygen barrier coating formulations



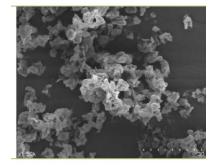
Powdered chitosan

3. Component in biodegradable formulations for food applications

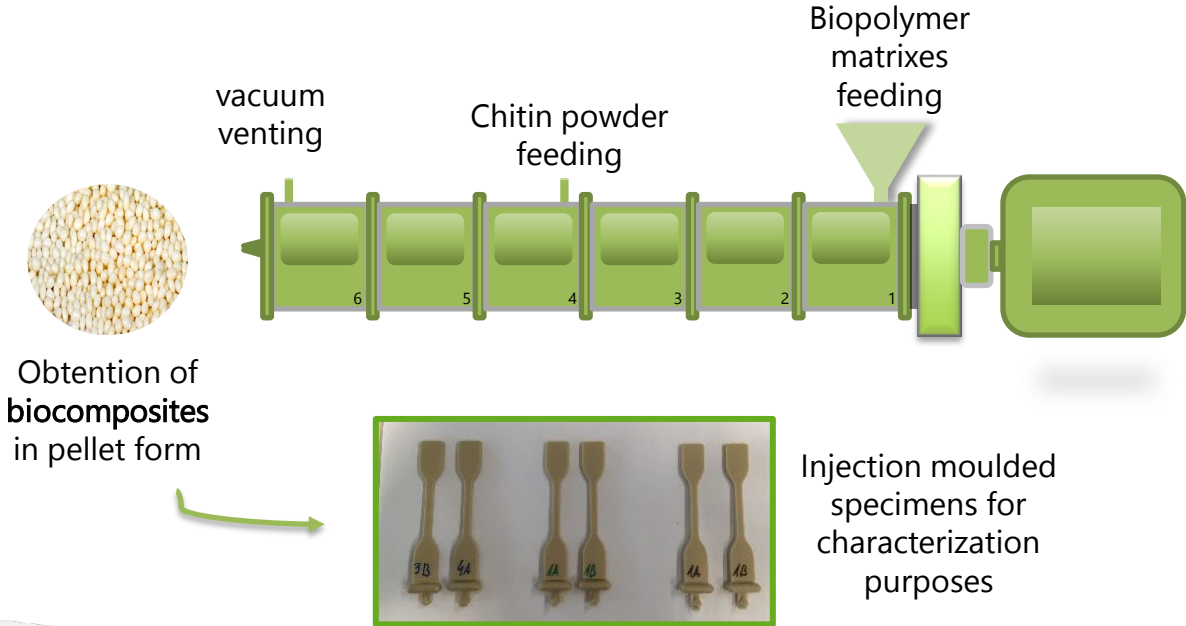
# Applications and main results



Chitin nanofibers

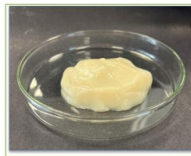


## 1. Additive in food Packaging materials



- The addition of chitin fibers **improved the thermal stability** of the biodegradable formulations.
- The Young Modulus of the composites increased as the content of nanofibers increased in the sample, as a consequence of a **reinforcing effect of the additive**
- A remarkable **decrease** in both the **oxygen and water vapor transmission rate** was observed, indicating the **positive effect of the incorporation of nanofibers**

## ➤ Applications and main results



Chitin nanofibers

### 2. Ingredient in high oxygen barrier coating formulations



Formulation of high-barrier coatings

Reference	Thickness ( $\mu\text{m}$ )	OTR ( $\text{mL}/\text{m}^2 \text{ day}$ )	Oxygen permeability ( $\text{mL } \mu\text{m}/\text{m}^2 \text{ day atm}$ )
Pristine PLA film	75	420	31500
PLA coated with ChNF based formulation	102	$35 \pm 6$	3699

The application of a coating based on chitin nanofibers resulted in a considerable decrease of the oxygen transmission rate. Considering the thickness of the sample, the oxygen permeability coefficient was calculated, and a **reduction 8.5** in the oxygen permeability was seen for ChNF based coating formulation.

# Applications and main results

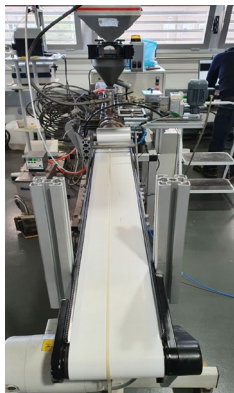
## 3. Component in biodegradable formulations for food applications



Powdered chitosan



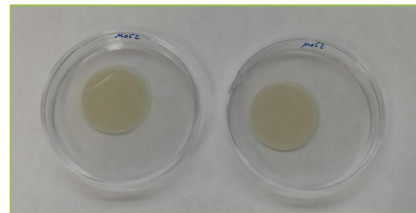
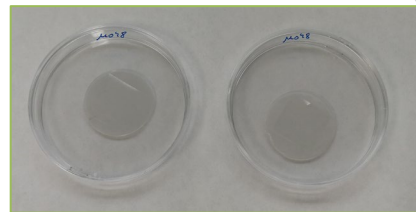
Plasticization of chitosan powder by mixing with biobased plasticizers and water



Extrusion processing  
(Scalable at industrial environments)



Biodegradable blends incorporated with thermoplastic chitosan



Interest and benefits?

Potential natural antimicrobial activity of chitosan

## ➤ How the solution responds/fits market requirements

- Production and extraction of complex compounds such as proteins, fats, and chitins.
- Use of chitin as a functional sustainable bio-additive in food packaging applications to improve the performance of biodegradable materials

## ➤ Future

- Use of larvae fractions for industrial, feed, and food applications
- Deep reflection on the existing legislation for its conscious and responsible modification



# Thank you!



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alejandro.aragon@itene.com

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