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Valorization of Food Waste for New Packaging Solutions

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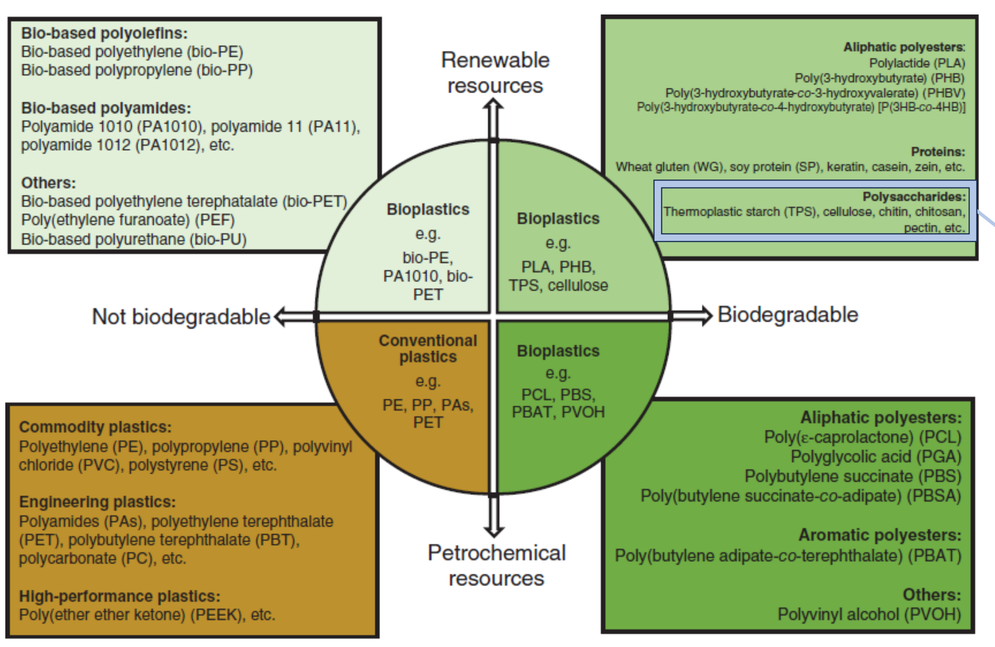
State-of-the-art

Plastic materials have long dominated food packaging sector due to their lightness, low cost, recyclability, and barrier properties. However, inadequate recycling and consumers' uncertainty about disposal methods pose serious challenges. As a result, legislation is pushing for reduced plastic use, leading to interest in alternatives like **bioplastics** derived from **food waste**.

Chitin, the second most abundant biopolymer after cellulose, has recently gained attention, especially in its deacetylated form, that is, **chitosan**. Being tipically extracted from crustaceans shells using chemicals-driven processes (Al Sagheer et al., 2009), chitosan has shown strong mechanical and barrier properties and a high solubility in slightly acidic water (Brugnerotto et al., 2001).



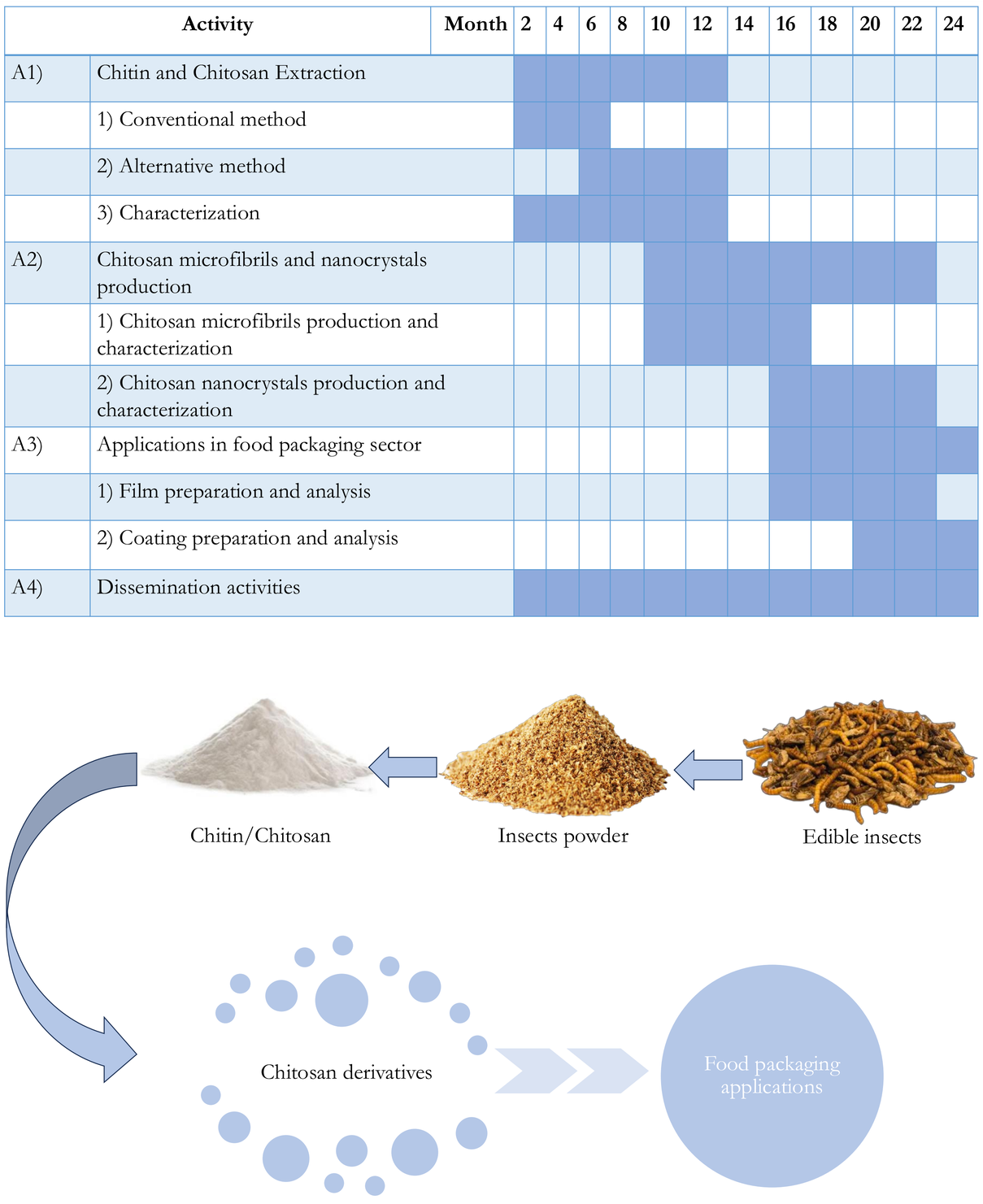
PhD Thesis Objectives and Milestone

	Activity	Month	2	4	6	8	10	12	14	16	18	20	22	24
A1)	Chitin and Chitosan Extraction		■	■	■	■	■	■						
	1) Conventional method		■	■	■									
	2) Alternative method				■	■	■	■						
	3) Characterization		■	■	■	■	■	■						
A2)	Chitosan microfibrils and nanocrystals production						■	■	■	■	■	■	■	
	1) Chitosan microfibrils production and characterization						■	■	■	■				
	2) Chitosan nanocrystals production and characterization									■	■	■	■	
A3)	Applications in food packaging sector									■	■	■	■	■
	1) Film preparation and analysis									■	■	■	■	
	2) Coating preparation and analysis											■	■	■
A4)	Dissemination activities		■	■	■	■	■	■	■	■	■	■	■	■

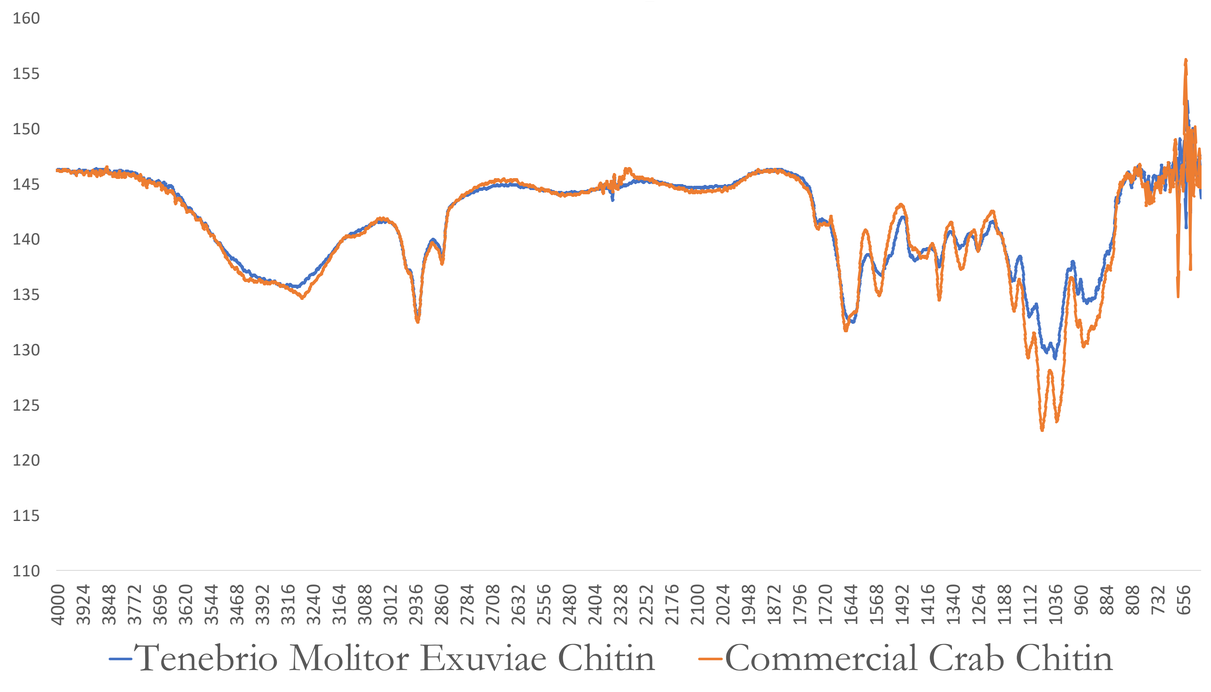
Relatively few studies focused on reducing the **environmental impact** of chitin extraction process, and the use of chitosan as a plastic alternative material remains underexplored, especially from unconventional sources.

Hence, this PhD project aims to extract chitin and produce chitosan from **edible insect residues** (e.g., *Hermetia illucens*, *Tenebrio molitor*) currently used for other purposes in food technology (Kaya et al., 2014). Other biomasses, like mollusk tissues and fungi, will also be investigated, with the ultimate goal to **standardize** an **eco-friendly** extraction method.

The resulting chitosan will then be miniaturized into micro- and nano-forms to design alternative packaging systems to conventional plastics, whose barrier, mechanical, and optical properties will be assessed.



FT-IR Comparison



Selected References

Al Sagheer FA, Al-Sughayer MA, Muslim S, Elsabee MZ (2009) Extraction and characterization of chitin and chitosan from marine sources in Arabian Gulf. Carbohydr. Polym. **77**: 410-419

Brugnerotto J, Lizardi J, Goycoolea FM, Argüelles-Monal W, Desbriès J, Rinaudo M (2001) An infrared investigation in relation with chitin and chitosan characterization. Polym. **42**: 3569-3580

Kaya M, Baublys V, Can E, Šatkauskienė I, Bitim B, Tubelytė V, Baran T (2014) Comparison of physicochemical properties of chitins isolated from insect (*Melolontha melolontha*) and crustacean species (*Oniscus asellus*). Zoomorphology. **133**:285-293