## OP-258 [Beekeeping Technology and Quality]
## Exploring Bee Pollen Microencapsulation as a Strategy for Food Preservation: Extending Shelf Life and Mitigating Food Waste

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Apis mellifera collect pollen, mix with saliva and/or nectar, transport it to hive, which later feeds larvae and young bees. Structure of pollen grains consists of two layers: inner layer (intine), composed of cellulose and pectin, outer layer (exine), primarily made of sporopollenin, which offers durability/protection. These properties render pollen promising natural alternative for microencapsulation technologies. Although pollen microcapsules have been used in pharmaceutical applications for drug loadings, their use in food technology remains to be explored. This gap in research was chosen for this study, aiming to extend shelf life of food products by including preservative-loaded microcapsules, contributing simultaneously to reducing food waste. Valorisation of bee pollen using innovative applications could enhance profitability of beekeeping activity. To develop pollen microcapsules, multifloral bee pollen samples from Northern Portugal were collected, separated by colour, subjected to purity assessment by microscopy analysis before several cleaning steps to extract internal biomaterial. Those pollen-empty shells were then loaded with potentially usable food preservatives. The emptied shells were loaded with food preservatives. The study examined microencapsulation potential of monofloral pollen from Castanea sativa, Erica sp., Rubus sp., Cistus sp., Olea europaea, using phenolic propolis extracts and preservatives (sorbic acid, lecithin, nisin) with passive and vacuum loading techniques. Passive loading efficiency of propolis ranged between 4% and 6%, depending on pollen type, whereas vacuum loading increased 29%-35%. After loading, biocapsules evaluated for their antioxidant activity using DPPH methodology. Results indicated various IC50 values across all pollens that propolis loaded, ranging from 0,057 µg/ml to 0,048 µg/mL.

Acknowledgments: The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support by national funds FCT/MCTES to CIMO (UIDB/00690/2020 and UIDP/00690/2020) and SusTEC (LA/P/0007/2021). Thanks to national funding, FCT for the Ph.D. research grant (2021.08361.BD) Seymanur Ertosun. Thanks to the NextGenerationEU recovery funds through the scope of Project BeeLand 10/C05-i03/2021.PPRR-C05-i03-I-000081

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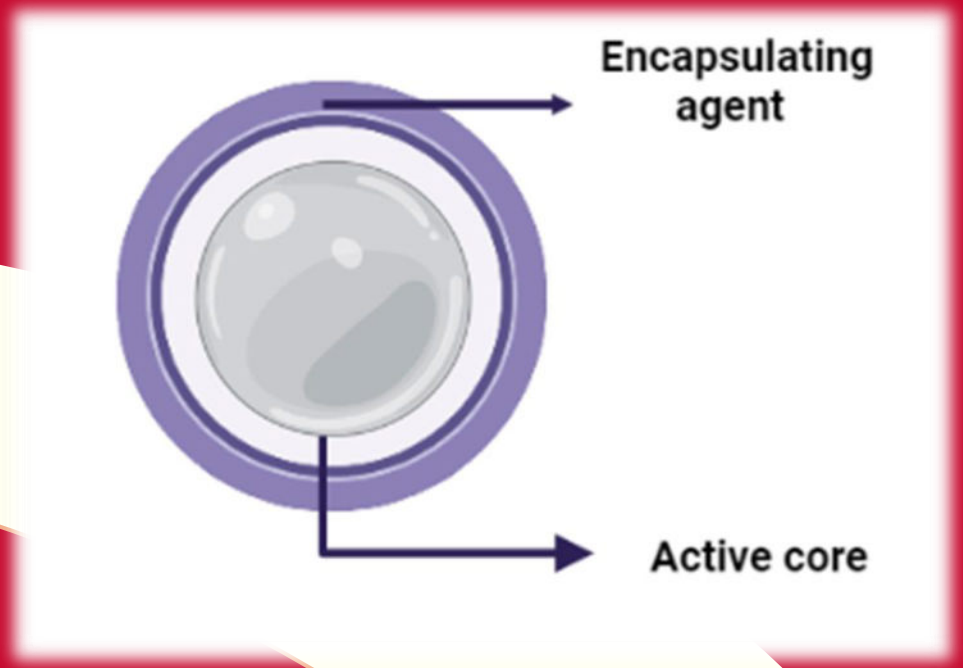
**Copenhagen, Denmark 2025**

# Context

- What is Microencapsulation?
- What is novelty in our research?
- Sporopollenin microcapsules
- Results
- Conclusion

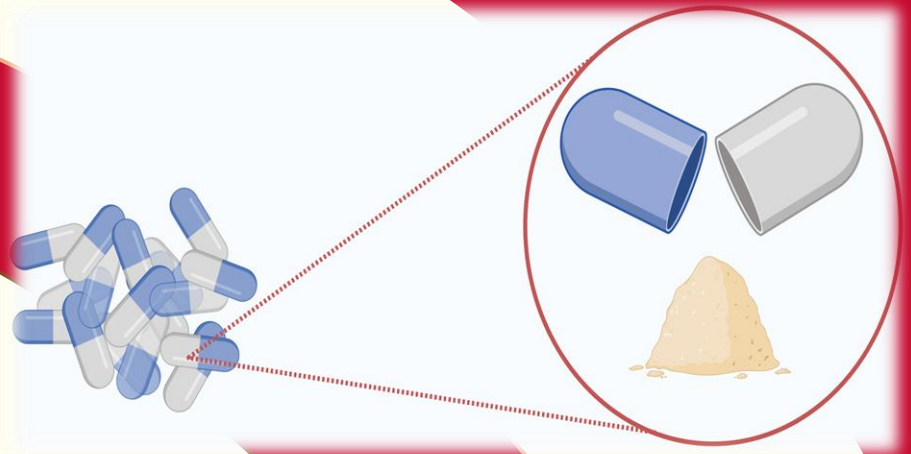


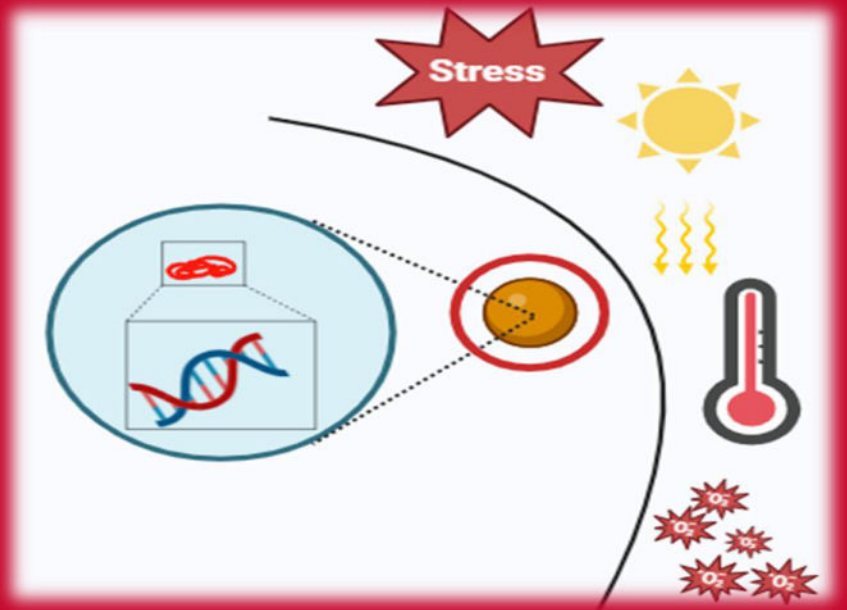

**Microencapsulation is a method that surrounding an active with a protective shield around it.**
**It may increase**

- **Oxidative stability,**
- **Thermostability,**
- **Shelf-life,**
- **pH differences**
- **Controlled-release of the active**

## Why do we need microencapsulation?

- To prevent degradation due to exposure to light, air, moisture, and other environmental conditions,
- Undesired chemical reactions,
- Improved stability and extended shelf life.

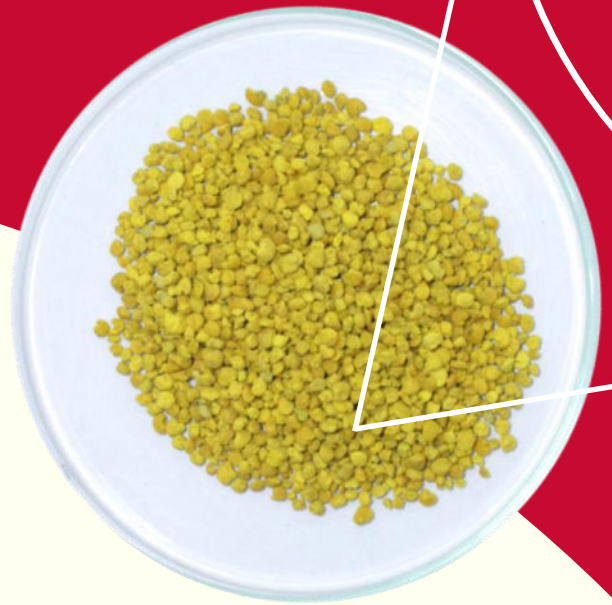


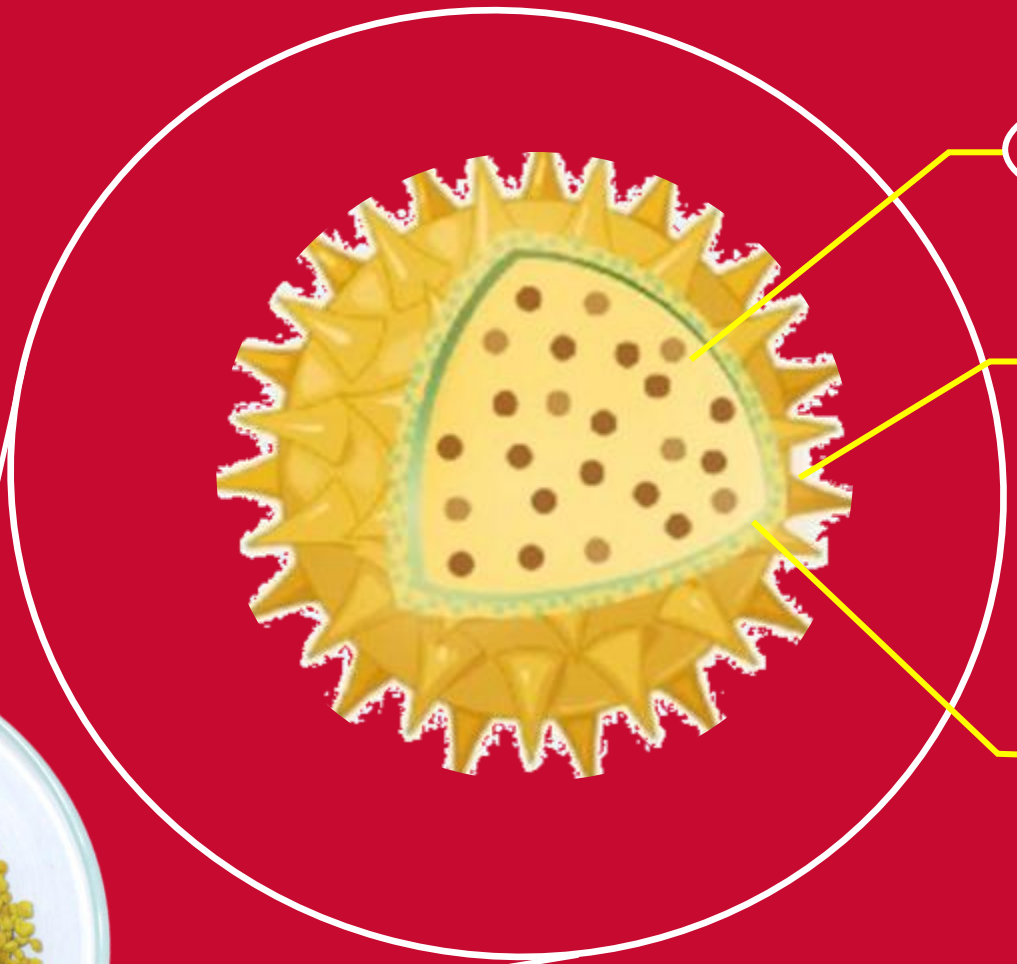


Bee pollen trap

Bee entering the hive

*No bees were harmed in this project





Cytoplasmic content

Pollenkitt

Exine (Sporopollenin)

Highly resistant polymer

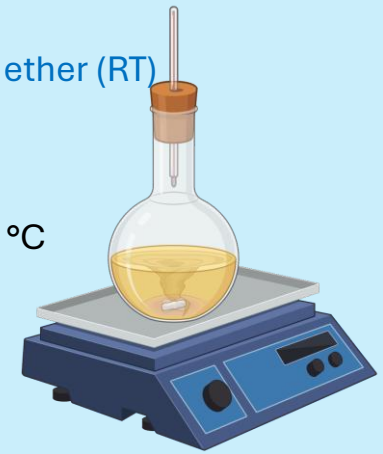
# Preparing Sporopollenin capsules

## 1. Defatting of pollen

Removing pollenkitt: oily compounds

Acetone
Water
Diethyl ether (RT)

50 °C



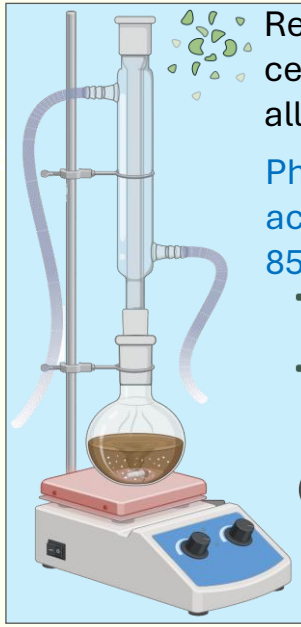
## 2. Purification of SMCs

Removing cellular and allergic materials

Phosphoric acid
85% (w/w)

8 h

70 °C

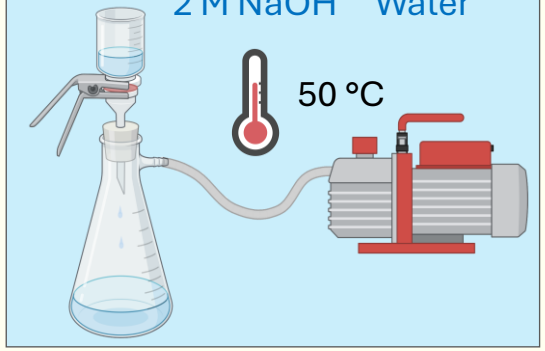


## 3. A series of washes

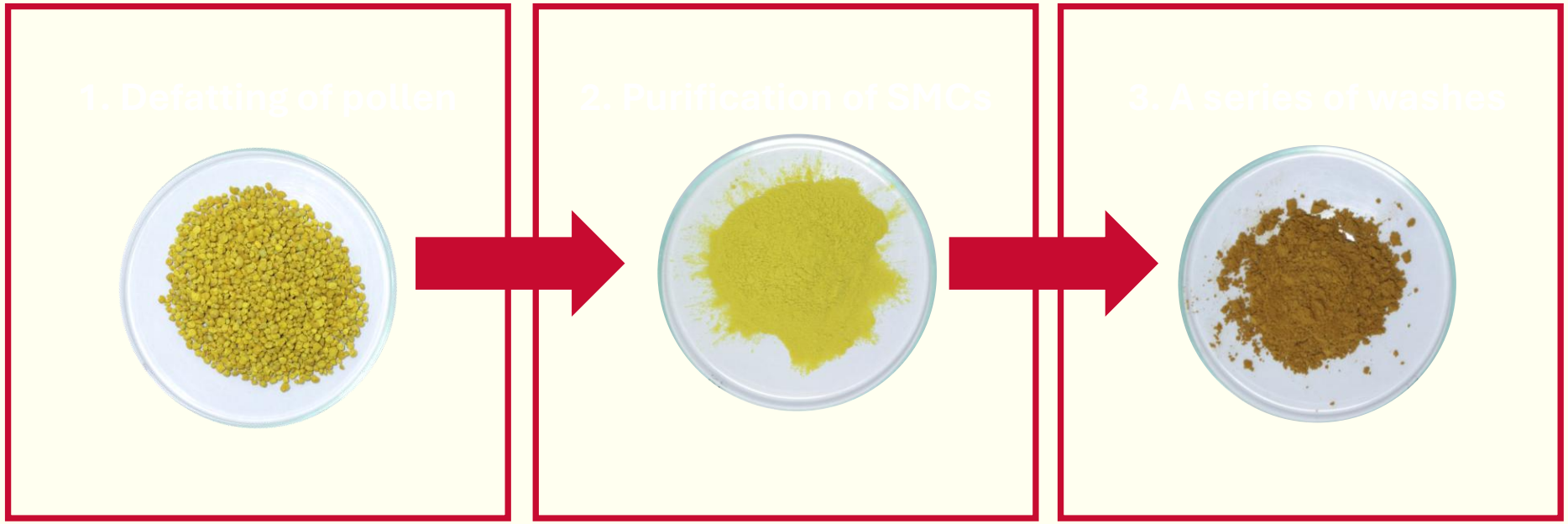
Removing residues and cleaning of SMCs

| | |
|---|---|
| Water | Water |
| Acetone | Acetone |
| 2 M HCl | EtOH |
| 2 M NaOH | Water |

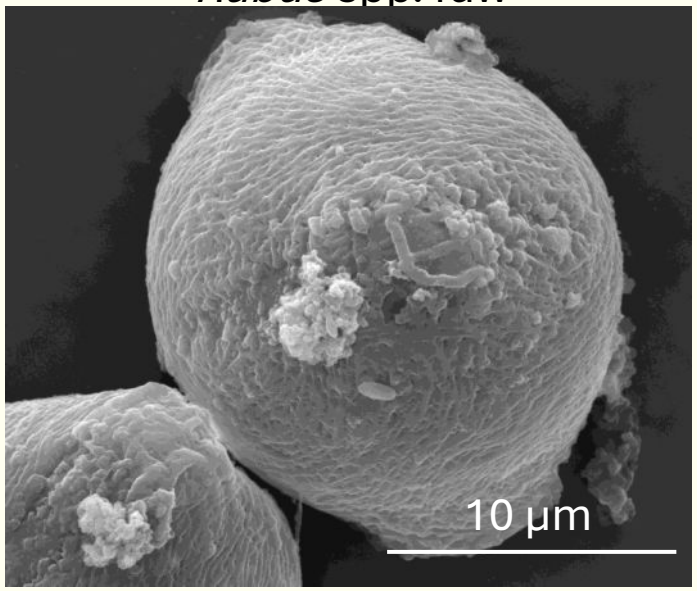
50 °C



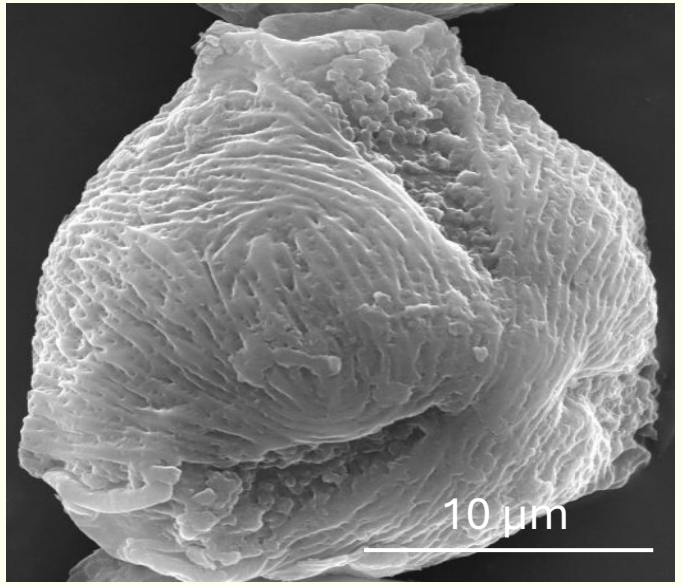
# Preparing Sporopollenin capsules



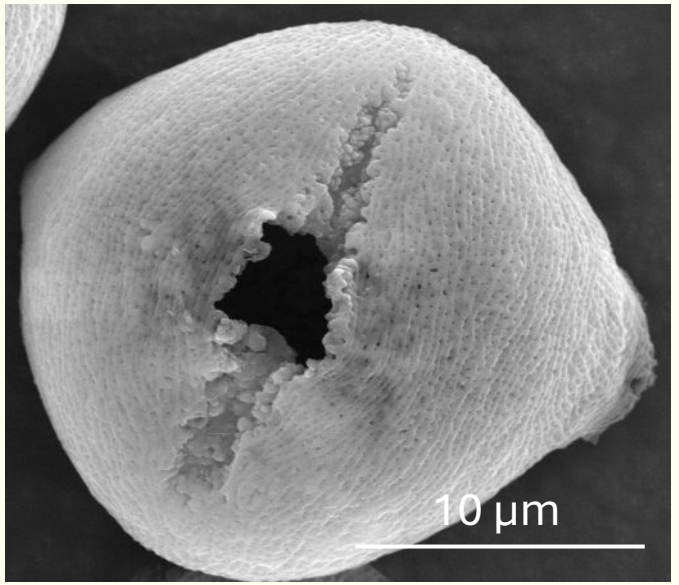
*Rubus* spp. raw



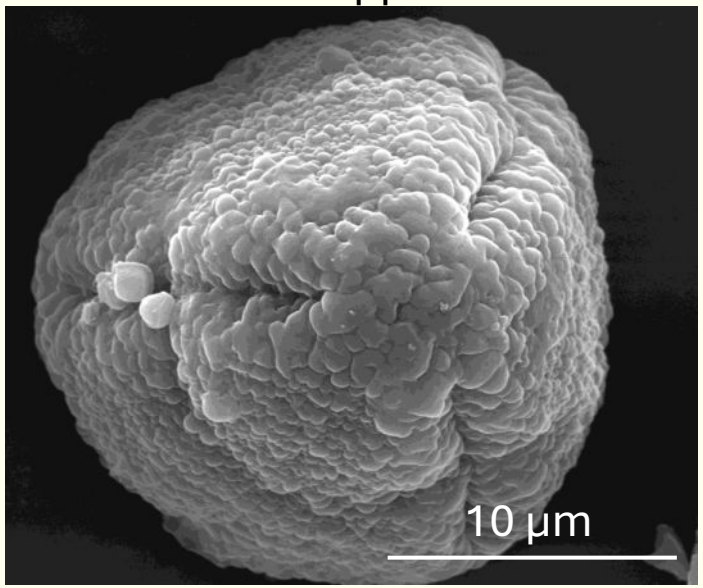

*Rubus* spp. defatted



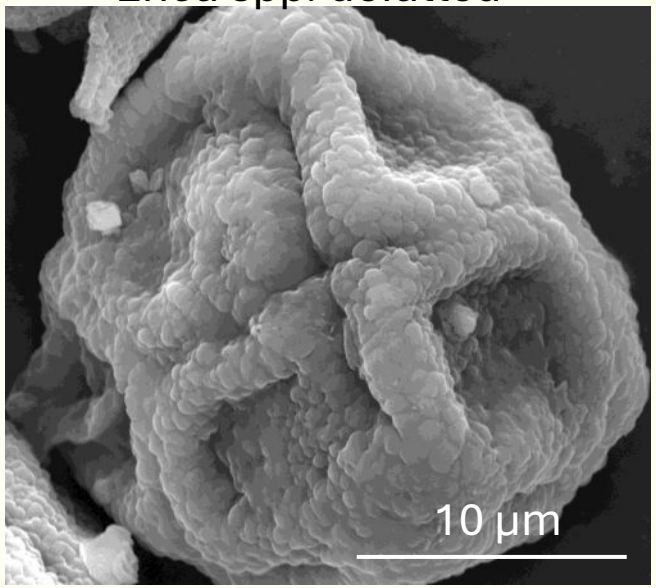

*Rubus* spp. cleaned



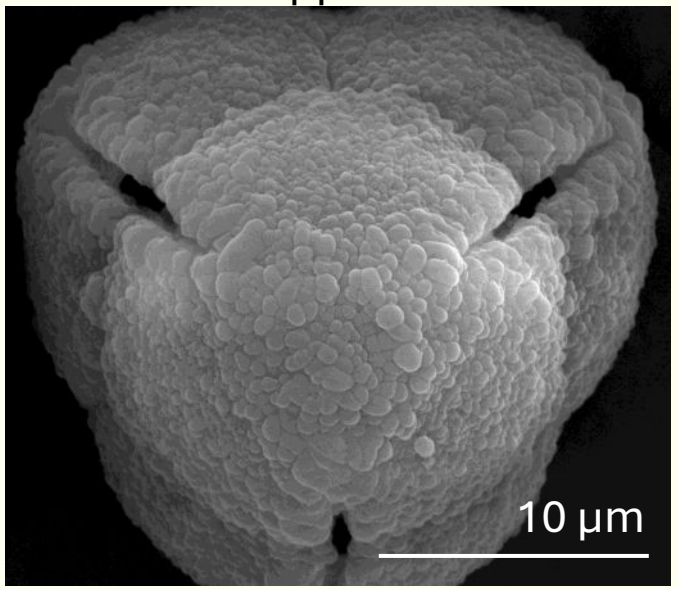

*Erica* spp. raw



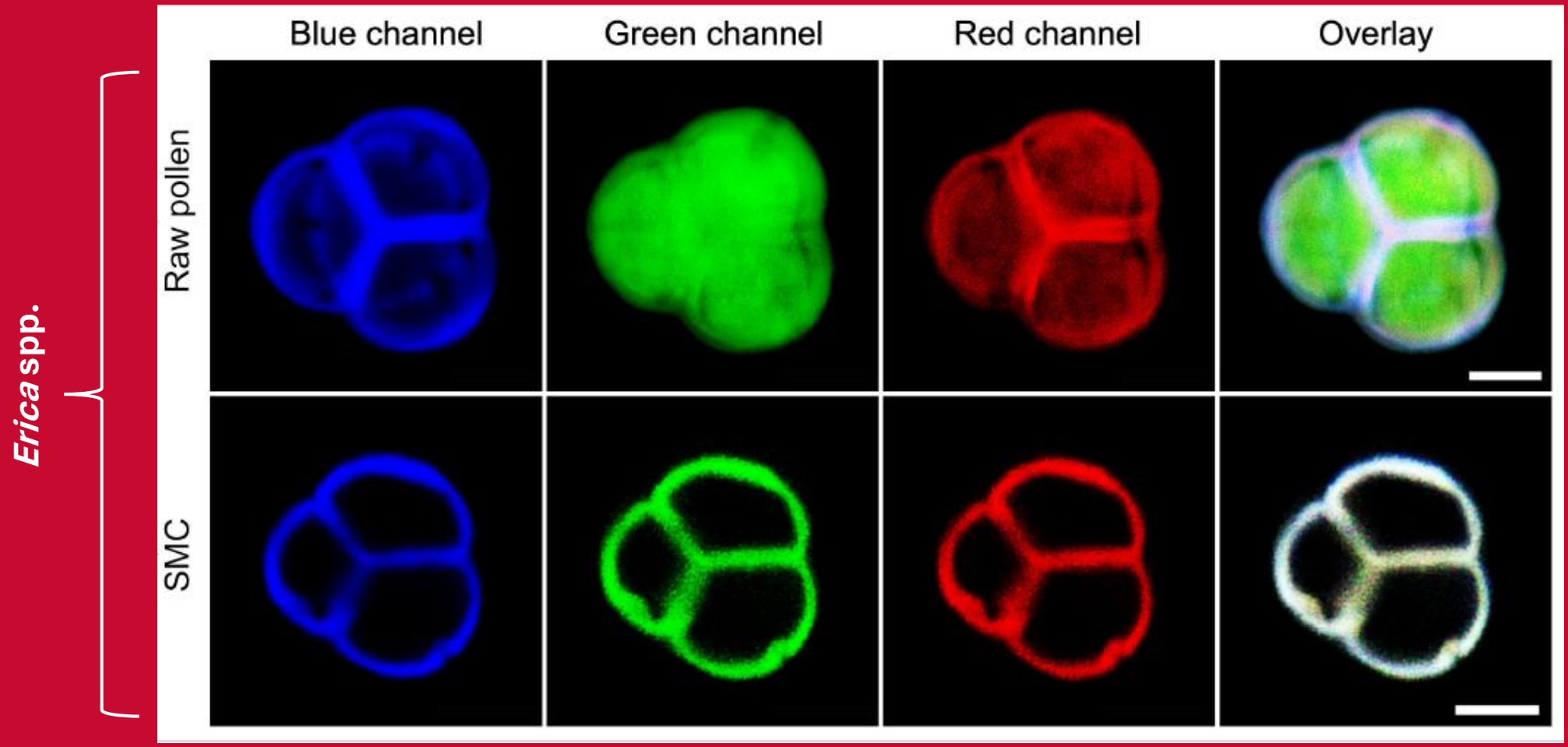

*Erica* spp. defatted

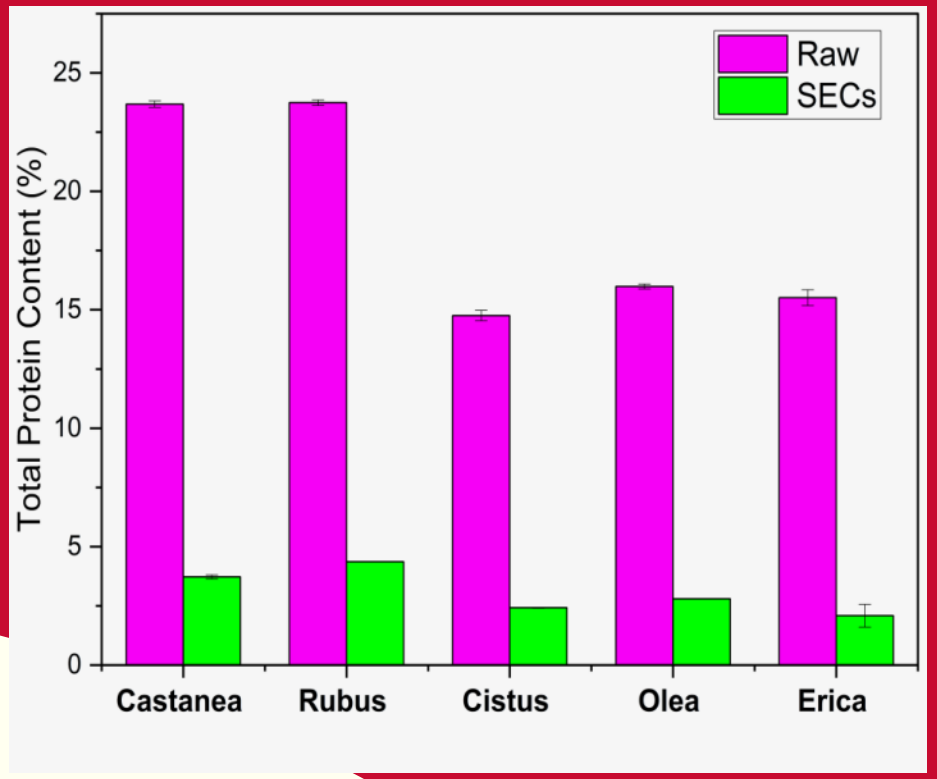



*Erica* spp. cleaned

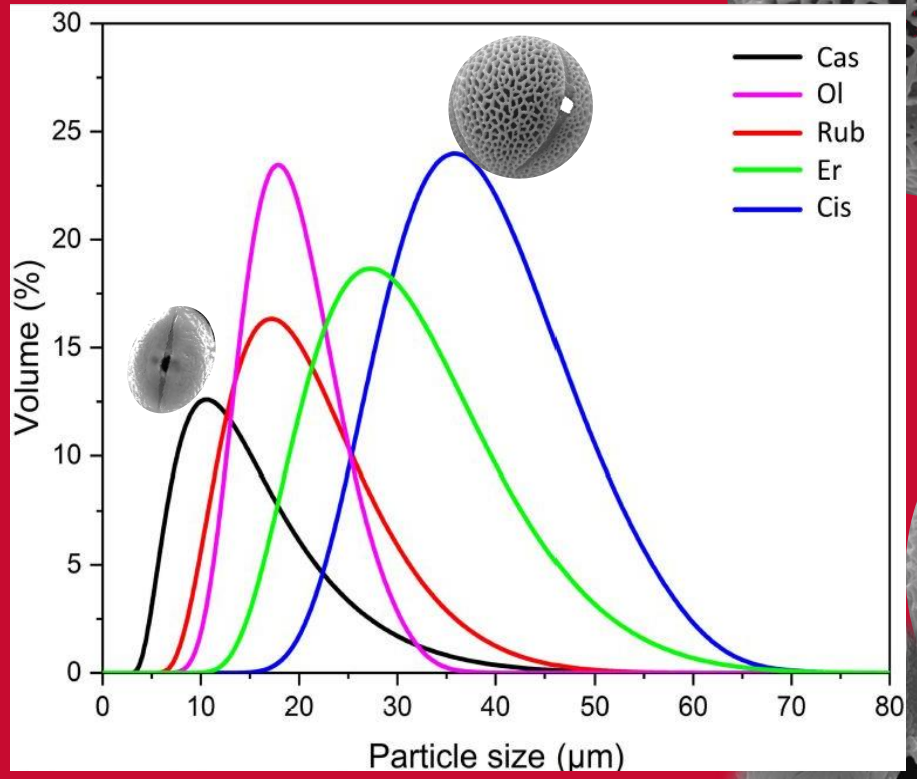


# CLSM of sporopollenin capsules

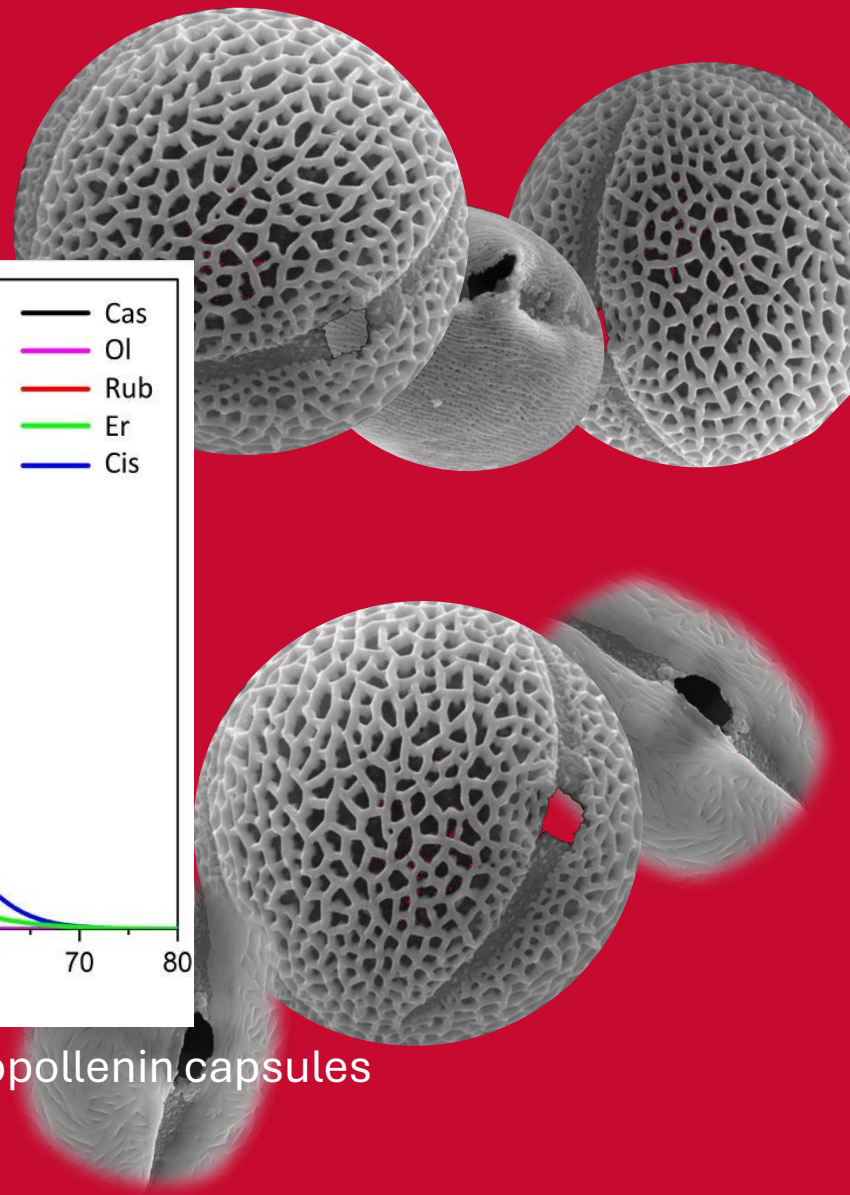





Protein content of sporopollenin capsules

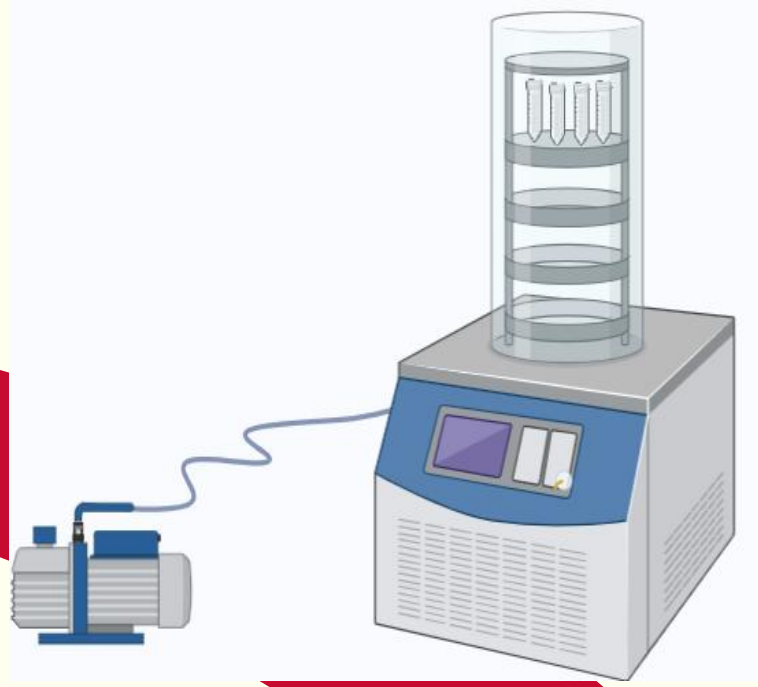


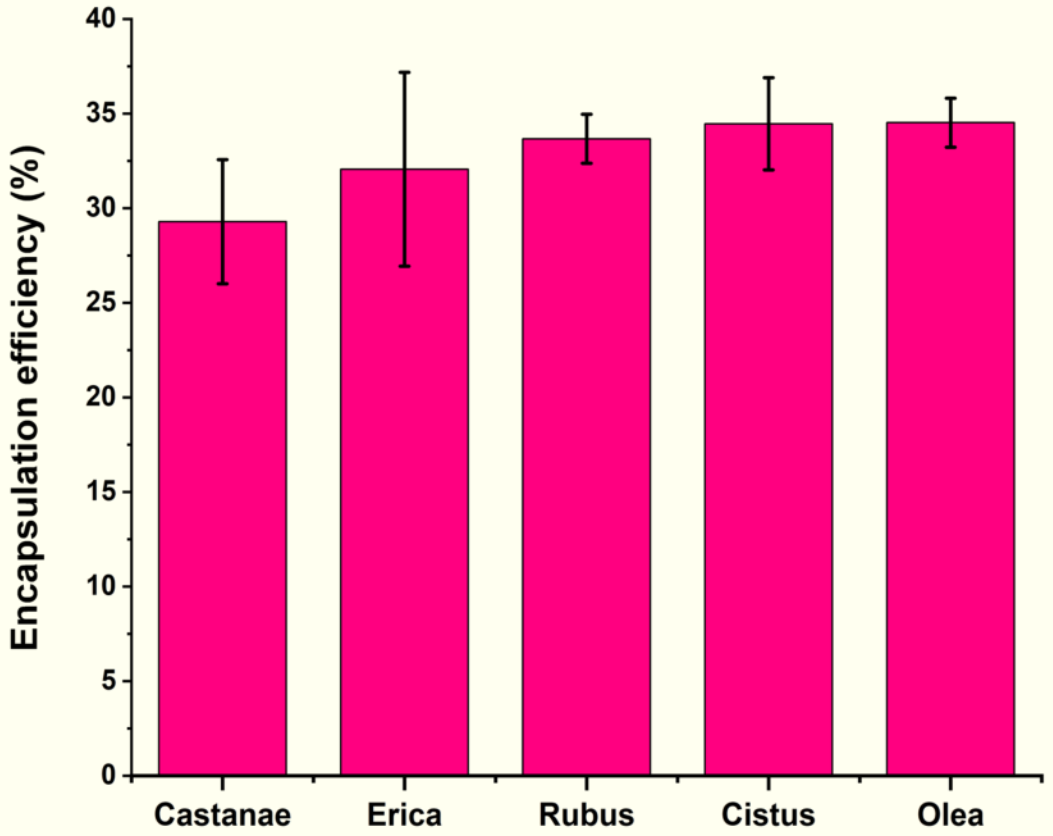

Particle size distrubution of sporopollenin capsules



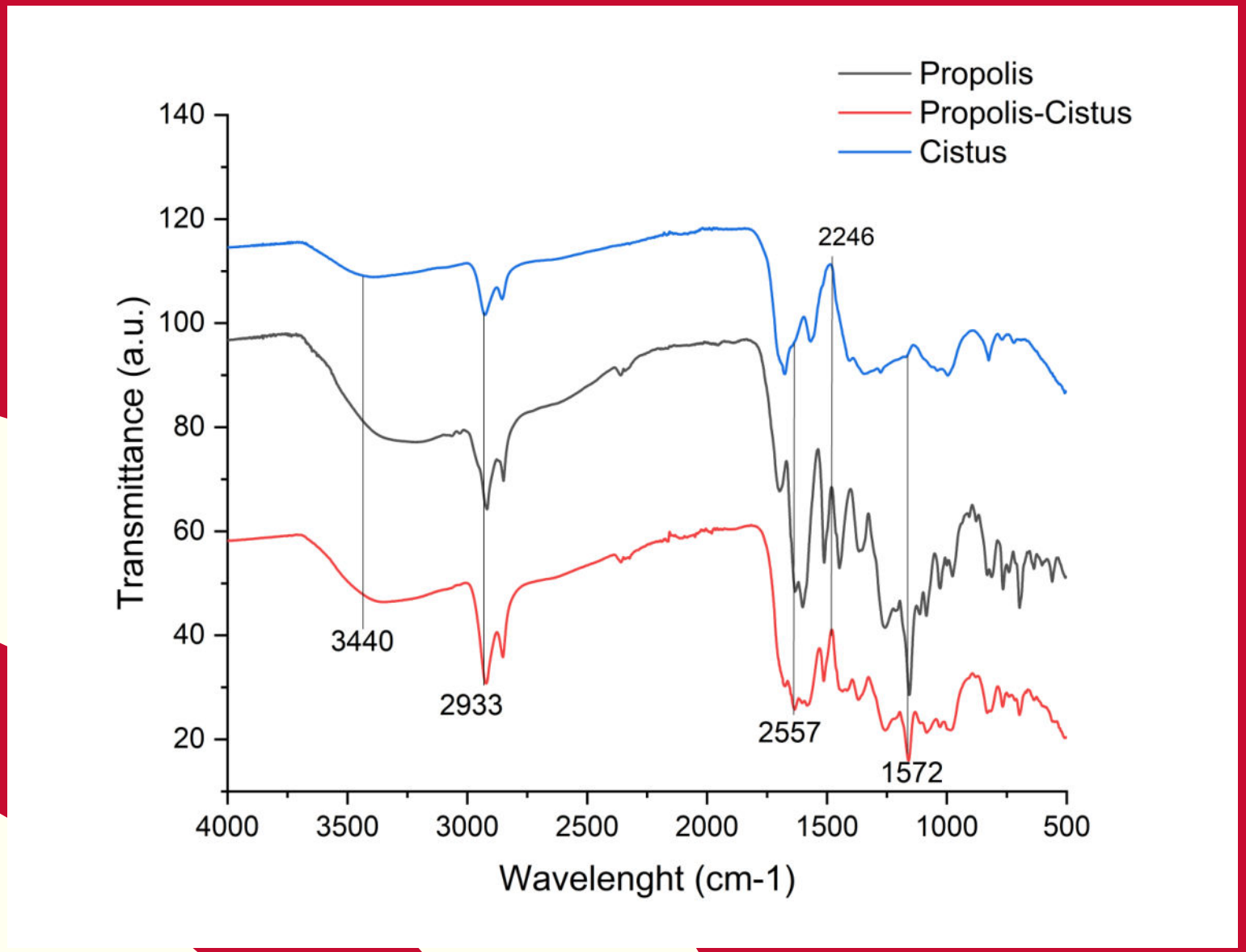
# Loading the capsules and encapsulation efficiency

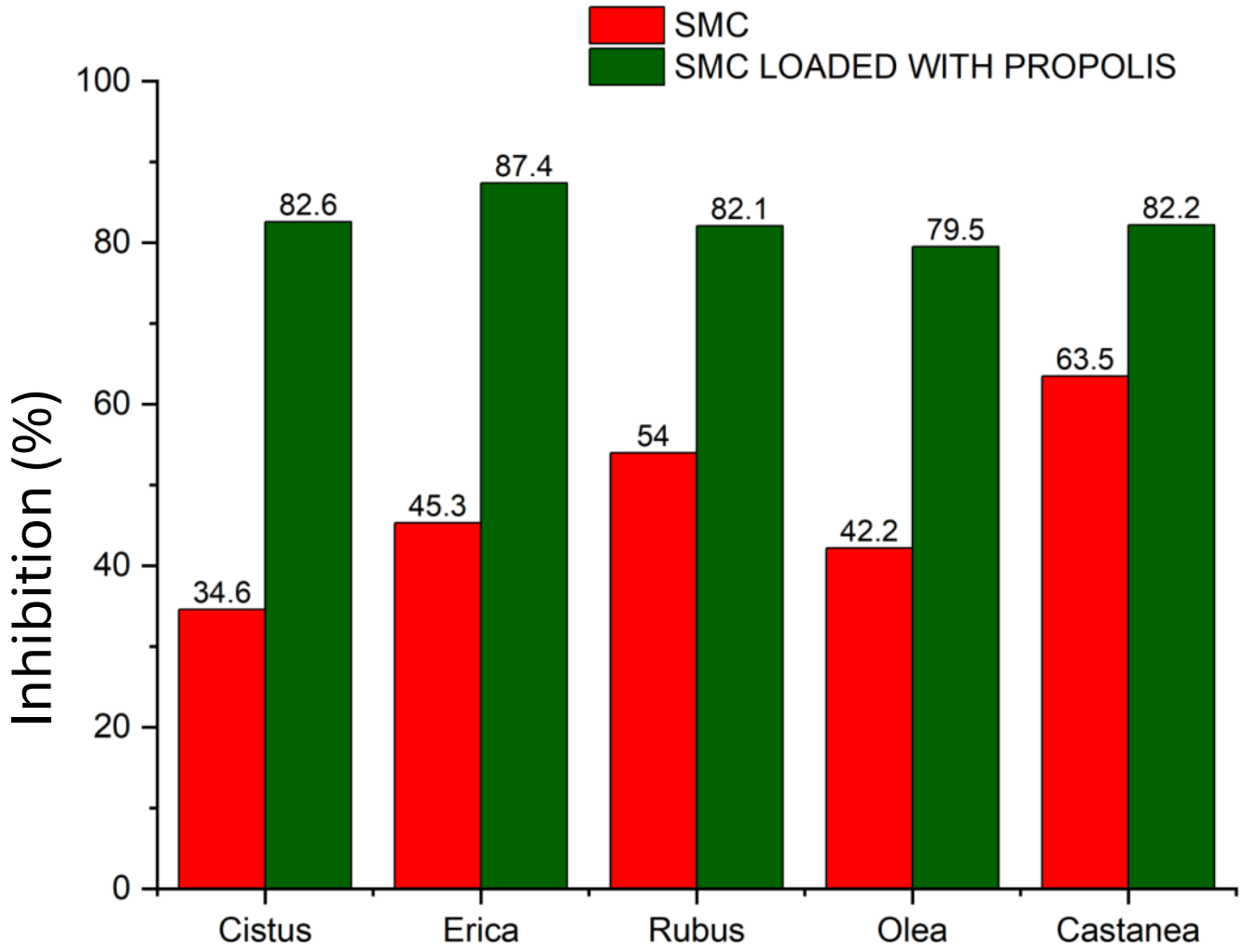
## 1. Vacuum loading technique



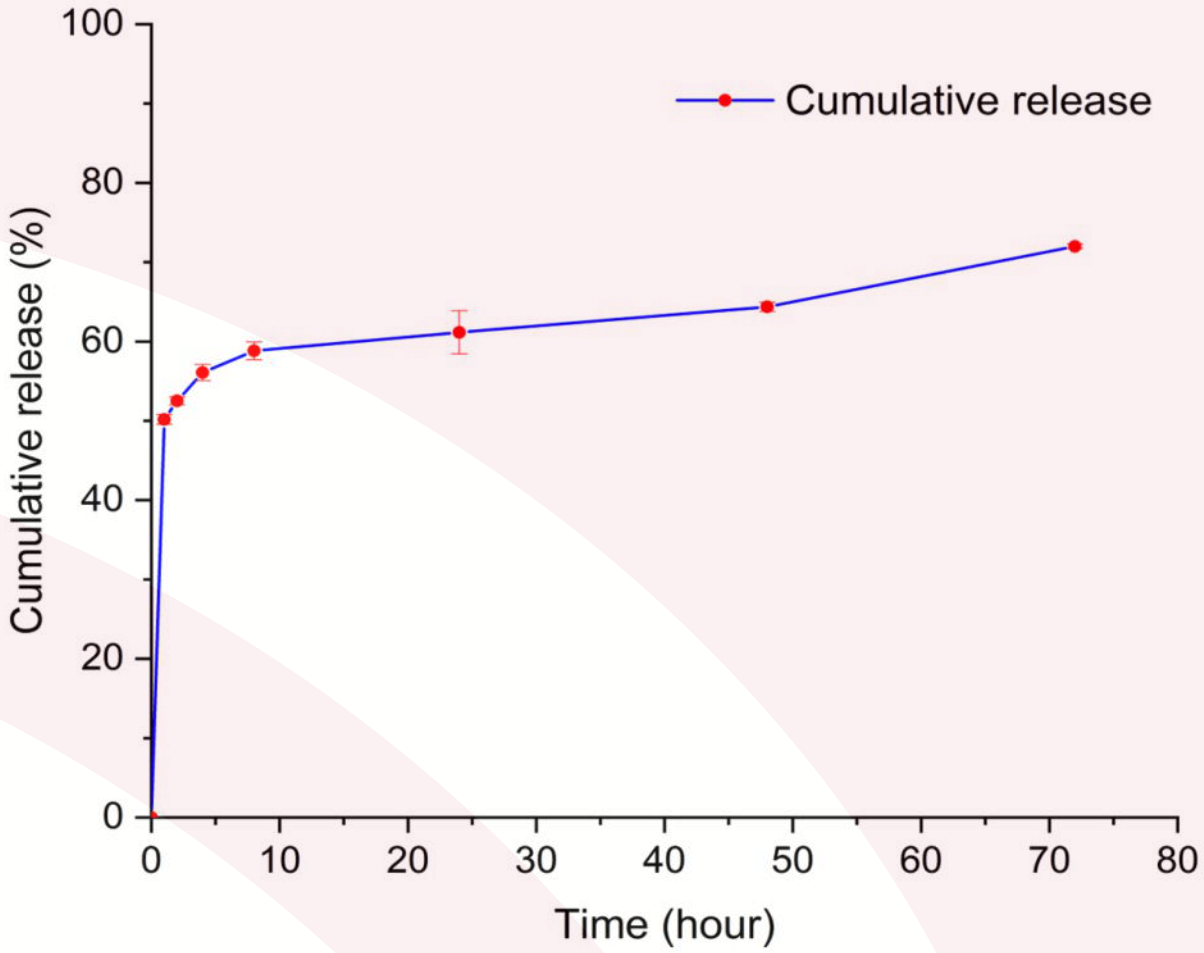


# Fourier-Transform Infrared Spectroscopy FTIR

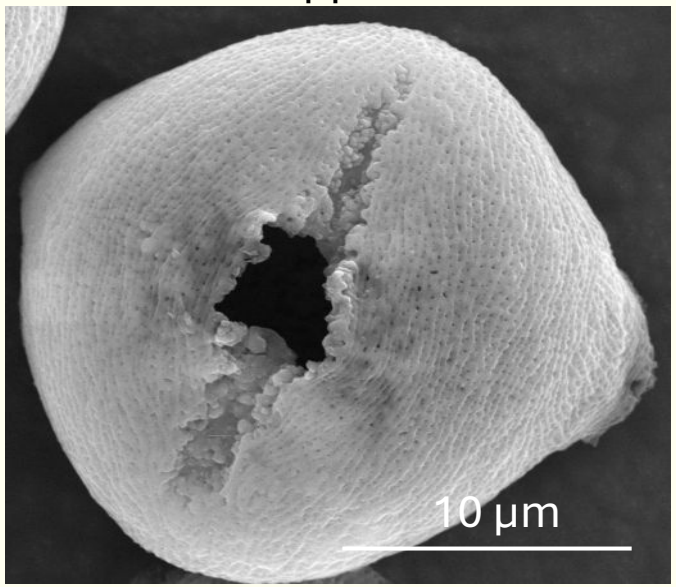



SMC
SMC LOADED WITH PROPOLIS
Inhibition (%)
100
80
60
40
20
0
34.6
82.6
45.3
87.4
54
82.1
42.2
79.5
63.5
82.2
Cistus
Erica
Rubus
Olea
Castanea

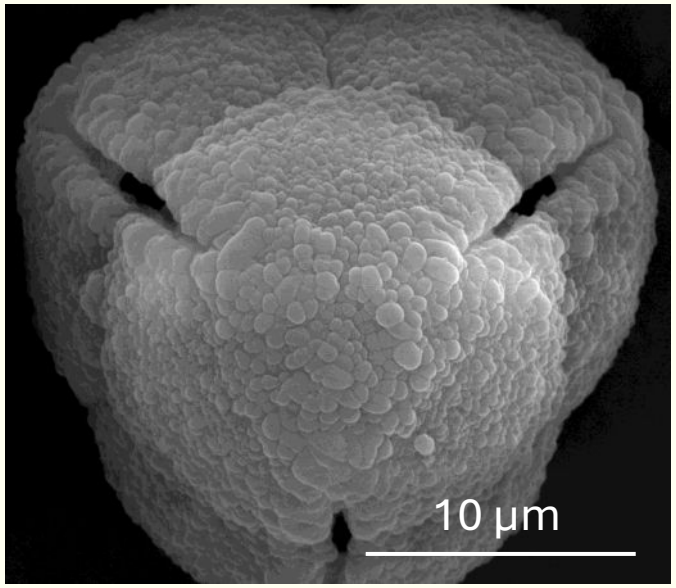
# Controlled release of Propolis from the SECs



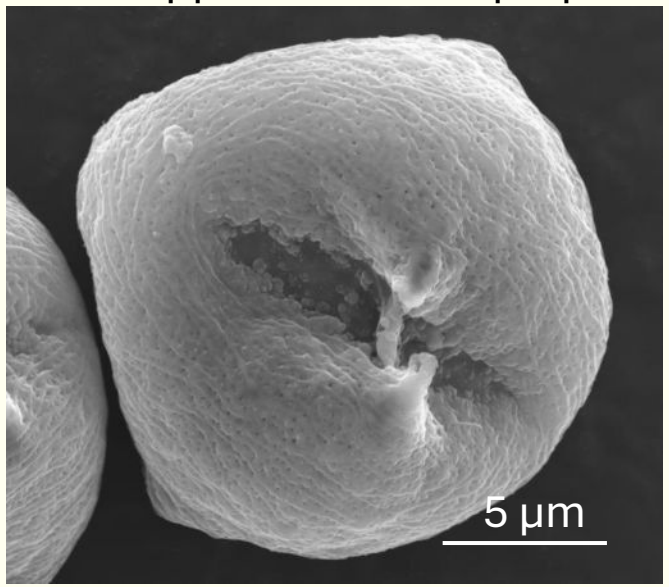
*Rubus* spp. cleaned



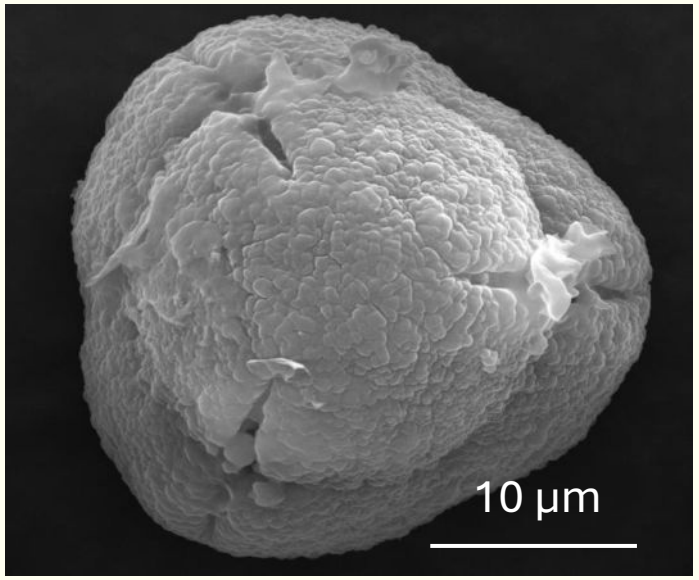

*Erica* spp. cleaned

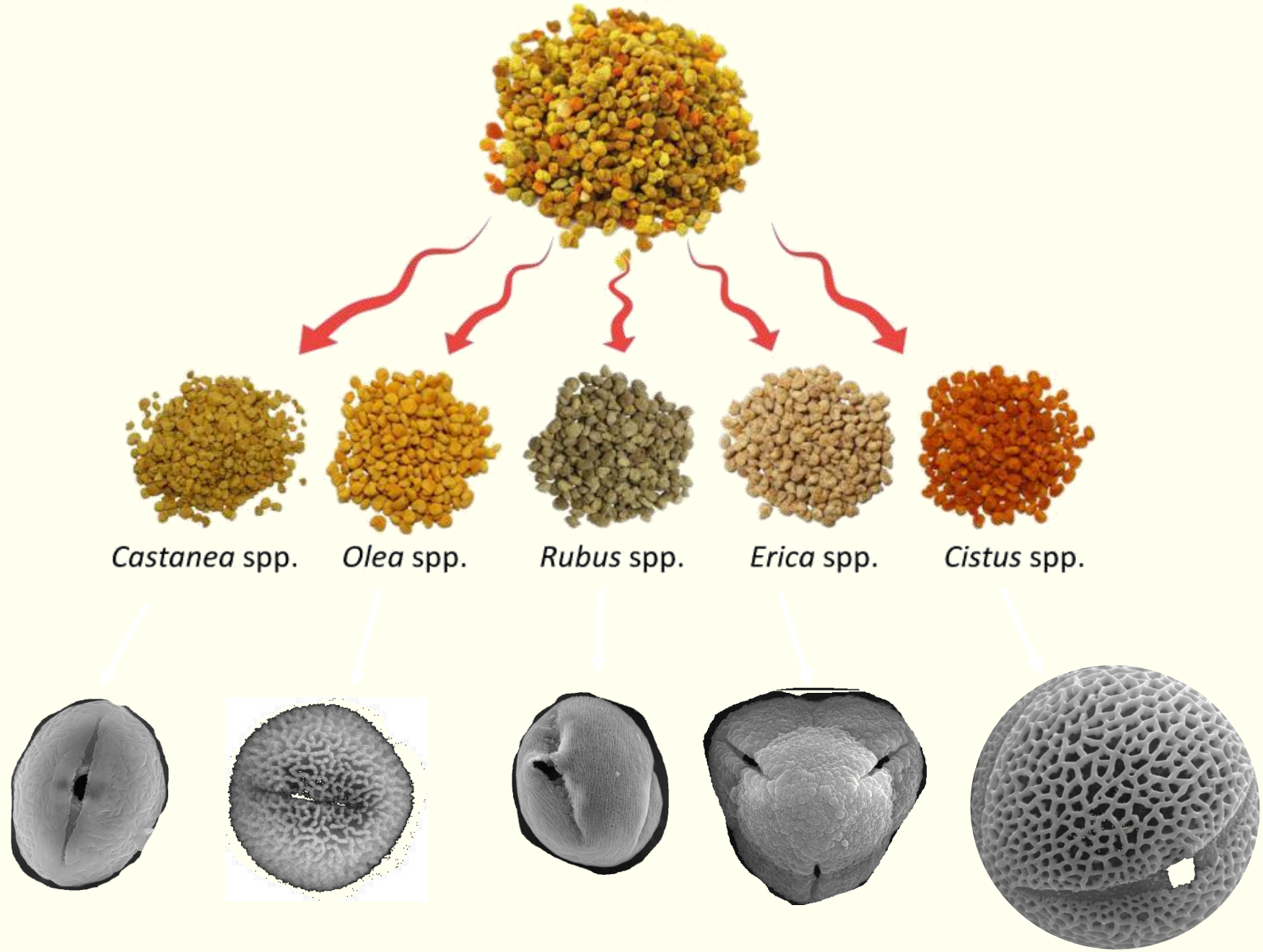



*Rubus* spp. loaded with propolis




*Erica* spp. loaded with propolis




*Castanea* spp.
*Olea* spp.
*Rubus* spp.
*Erica* spp.
*Cistus* spp.