Science Europe Scientific Advisory Committee (SAC)

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"Building a Scientific Narrative on Impact and Societal Value of Science"

Nano-encapsulation: a method to maximize the health benefits from medicinal plants and agro-food by-products

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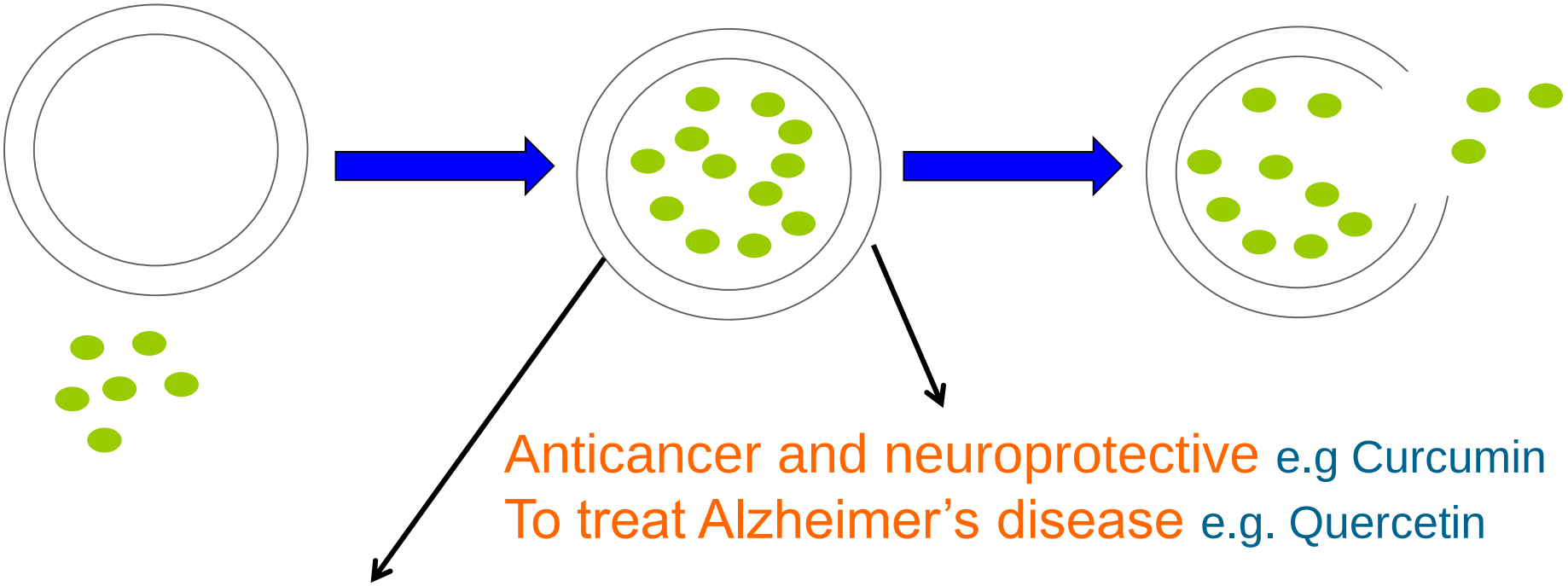
#SEimpact

What is nano-encapsulation?

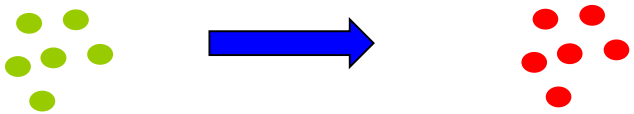


Anticancer and neuroprotective e.g Curcumin
To treat Alzheimer's disease e.g. Quercetin

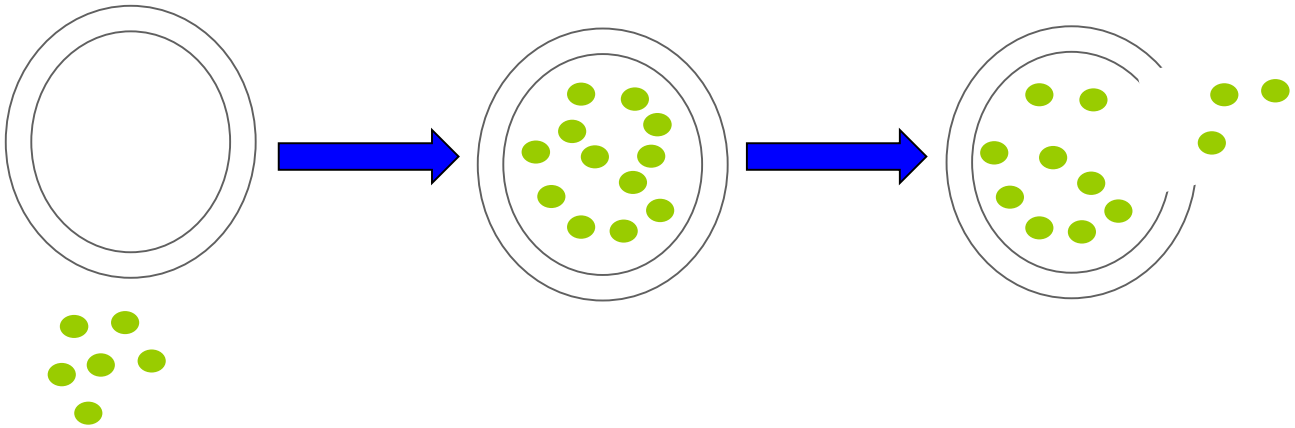
Solid liquid nanoparticles are biocompatible, biodegradable, easy to prepare, potential for scale up and low cost
e.g. Poly ethylene glycol, poly-ε-caprolactane, quillaja saponin

What would happen in absence of nano-encapsulation?

Food matrix influence on bioavailability



The preservation effect of nano-encapsulation



From research to application

- **How did we achieve the knowledge about the potential of nano-encapsulation?**
  - Share of knowledge with the scientific community and stakeholders
- **Further continuous cooperation and search for:**
  - New bioactive compounds from plant extracts
  - Other specific activities
  - Forms of preservation by nano-encapsulation

From the challenge…

- Medicinal plants and most agro-food by-products are valuable sources of biologically active molecules (e.g. polyphenols, phenolic acids, terpenes), which could be used as **nutraceuticals**.

Nutraceuticals are relevant since they are expected to increase the resistance of individuals to diseases: eg, CVD's

- However, most of their proved *in vitro* effects are not achieved *in vivo* because these molecules present:

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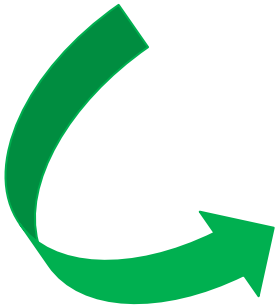
…To the solution

- Low *in vivo* bioavailability;
- Limited gastrointestinal residence time, low absorption and/or solubility within the gut;
- Chemical and physical instability (temperature, oxygen, light, pH, enzymes, presence of other nutrients) contributing to the limitation of their nutraceutical and pharmaceutical activity



A solution for these constraints is nano-encapsulation

Impact of nano-encapsulation

- Protection of products from oxidation
- Increased bioactive resistance under acidic and bile salt conditions- Preservation until intestinal absorption
- Improved thermotolerance
- Taste and odour masking
- Enhanced/controlled delivery of nano-encapsulated bioactives
- Improved bioavailability and biological activity
- High precision in food quality

Future research needs for the success of nano-encapsulation

1 **Selection of appropriate core materials to produce nanoparticles based on:**

i. Chemical properties of compounds to be encapsulated
ii. Delivery site

2 Production of nanomaterials:

i. Specific equipment to produce different types of particles LbL (e.g. layer by layer),
ii. HPH (high shear homogenization) extrusion, etc

3 Nanoparticles/nanomaterials characterization:

i. Mean size, zeta potential and stability
ii. Loading and release properties
iii. Biocompatibility and toxicity (several in vitro assays using cell lines)

4 Characterization of final product (Proof of concept):

i. Improvement of biological effect
ii. In vitro/in vivo correlations
iii. Scale-up opportunities

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KEY MESSAGE

Potential major impact on society

- Reduce cancer death in the world:
  - 8.2 M /year
  - 70% Increase in the next 2 decades
  - Costs (2010) 1000 M€
- Reduce other leading causes of death in the world:
  - Ischaemic heart diseases 7.0 M/year
  - Stroke 6.7 M/year

Source: WHO