

**CO<sub>2</sub> 1<sup>st</sup> choice for  
sterilization**



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# Survey of process applied for sterilization



Grade of contamination:	103 cfu/g	low
according to micro counts	104	weak (EAB cat 3B plant derived pharmaceuticals)
	105	medium
	107	strong

## Process

- Ethylene oxide
- Ozone
- Pulsed electric fields
- Steam/vacuum
- Micro waves, IR
- Extrusion
- Hydrostatic pressure
- Peroxide/hot steam
- Radiation

## Drawback

ethylen chlorhydrin, cancerogen, prohibited  
structure change  
novel food directive  
structure change: maillard, protein denaturation  
moisture  
moisture  
>200 MPa (2000 bar), water required  
structure change  
labeling, low acceptancey

# Inactivation by CO<sub>2</sub>- treatment - Theories -



- Interfering cell metabolism
  - a) pH decrease: (at 100-250 bar: pH ~ 3 )  
enzyme inactivation (decarboxylase)  
extraction/denaturation
  - b) Cytoplasmatic cell wall modification  
lipid extraction  
lipid bilayer permeability and fluidity
  - c) Immobilization/precipitation of important ions like  
Mg/CaCO<sub>3</sub> upon pressure release
- Mechanical rupture of cells (largely ruled out)

# Enhancers for CO<sub>2</sub>- based effects



Temperature

Water

Peroxides (e.g. peracetic acid)

Alcohol

Agitation

Pressure cycling (particularly cycle-type treatment)

Time/duration under pressurized and non-pressurized conditions

Particle size



**Spores cannot be killed as such**



# Commercially viable application for CO<sub>2</sub> - treatment



## Examples

- Powdered drug formulation (intermediates like tannines etc.)
- Exudates like resins, waxes (pollen, bees wax)
- Large molecules based pharmaceuticals
- Biodegradable polymers (protein isolates)
- Plant tissues without highly soluble essential oils

## Issues

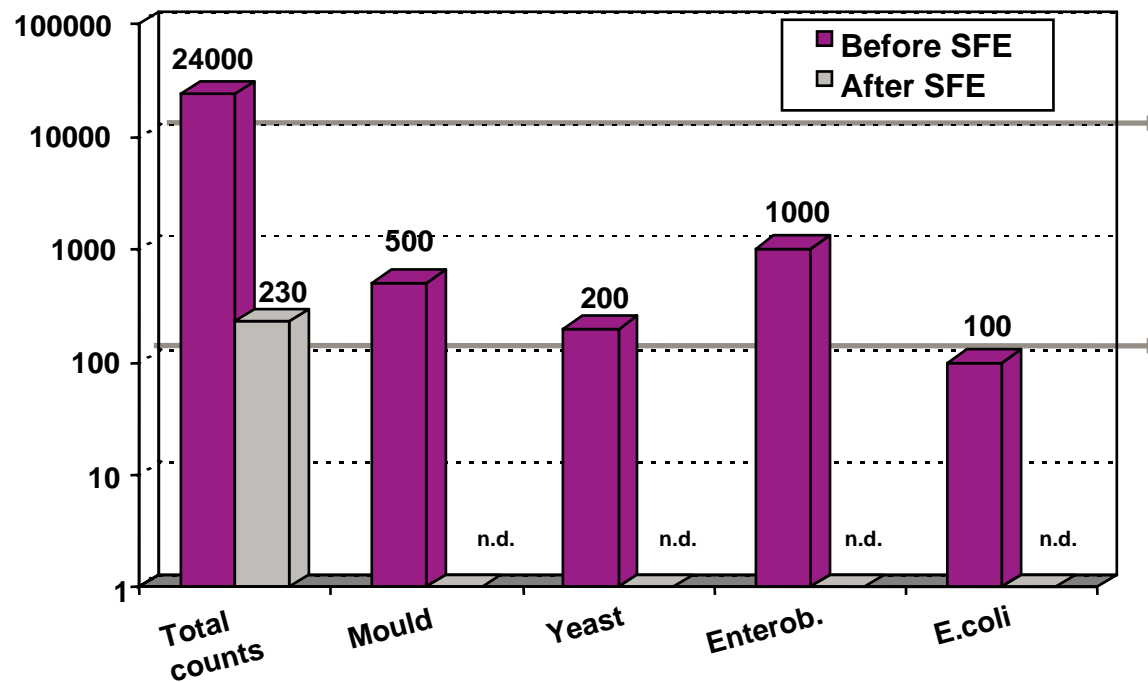
- Change of functionalities (precipitation /denaturation, solubility)
- Co-removal of valuable compounds like essential oils, fat etc.
- Particle size alteration
- Sterilization assurance level 10<sup>-6</sup>

# Inactivation of food borne and human vegetative micros in brazil nuts



Situation: heavy bacterial contamination by non-appropriate harvest conditions, climate etc.

Goal: effective sterilization without affecting functionality



Mesophile micros  
< 1 x 10<sup>4</sup> cfu/g

Mould/yeast  
< 1 x 10<sup>2</sup> cfu/g

Enterbacter.  
< 1 x 10<sup>2</sup> cfu/g



Reduction of micros acc.  
to pharmaceutical specs

n.d.= not detectable



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