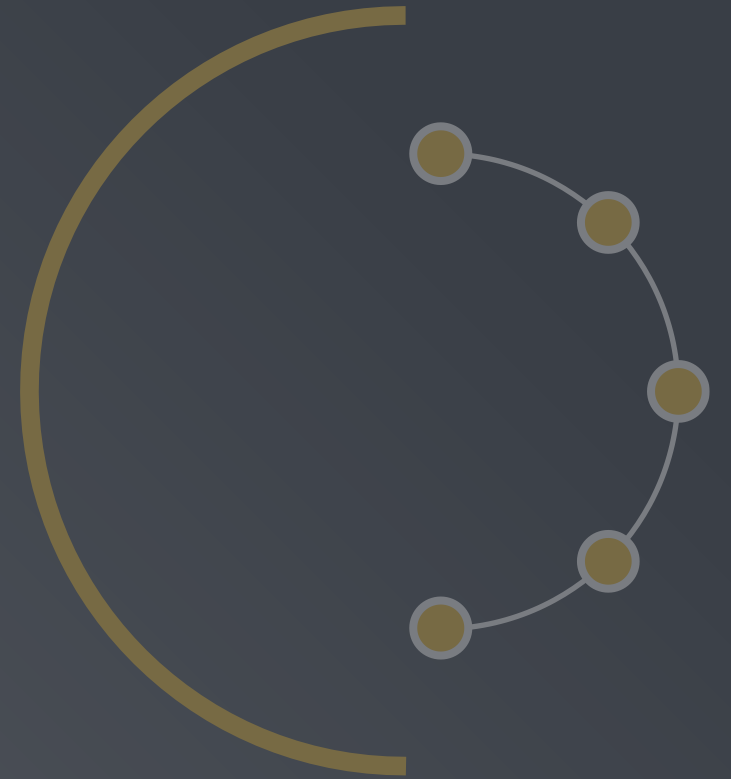


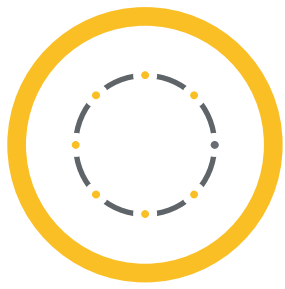


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# Cyclodextrins

*In fragrance encapsulation*

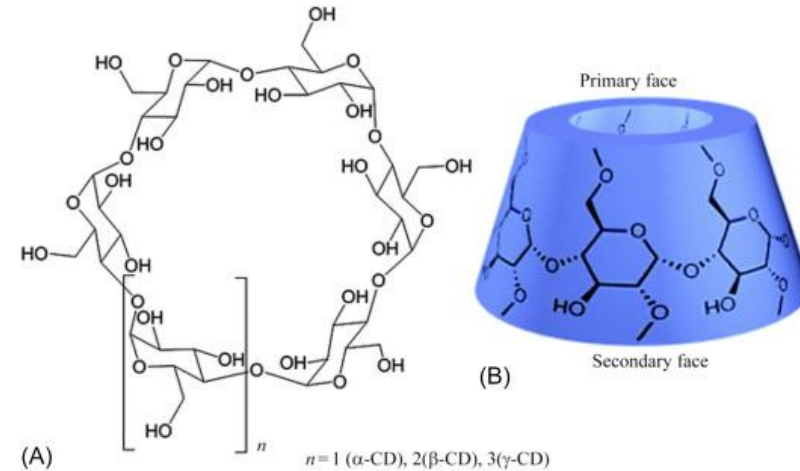


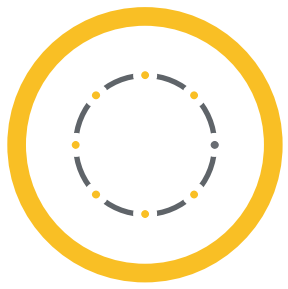
# What are cyclodextrins?

## Properties & applications

- Composed of sugars
- Cyclic molecules
- Naturally occurring
- Used in food, pharmaceuticals, drug delivery, chemical industries, agriculture, etc.
- Sub-nanometer sized molecular containers with hydrophilic outer phase and hydrophobic interior properties
- Reversible inclusion complex formation

## Structure & MoA





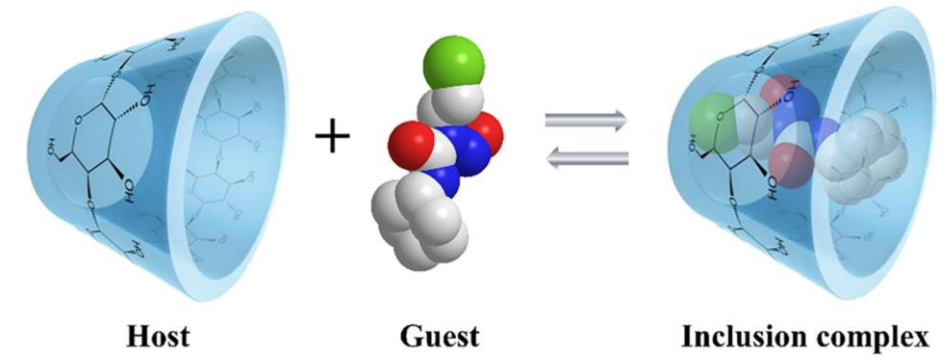
# What are cyclodextrins?

## Traditional pharma applications

- CDs as drug complexing agents in drug delivery
- Nanosizing, solubilizing, stabilizing, etc.
- Summary of results: >100 marketed products in 2021

## Novel applications

- Active ingredients
- Monoclonal antibodies
- Gene therapy
- Targeted therapies
- Diagnostics & Theranostics
- Biotechnology



## Common Advantages

- Cyclodextrins may increase
  - Drug solubility
  - Wetting, dissolution rate
  - Drug stability
  - Absorbed quantity
- Cyclodextrins may decrease
  - API's dose for same efficacy
  - Taste
  - Side effects
  - Smell



# Complex association and dissociation mechanism

Concentration ratios

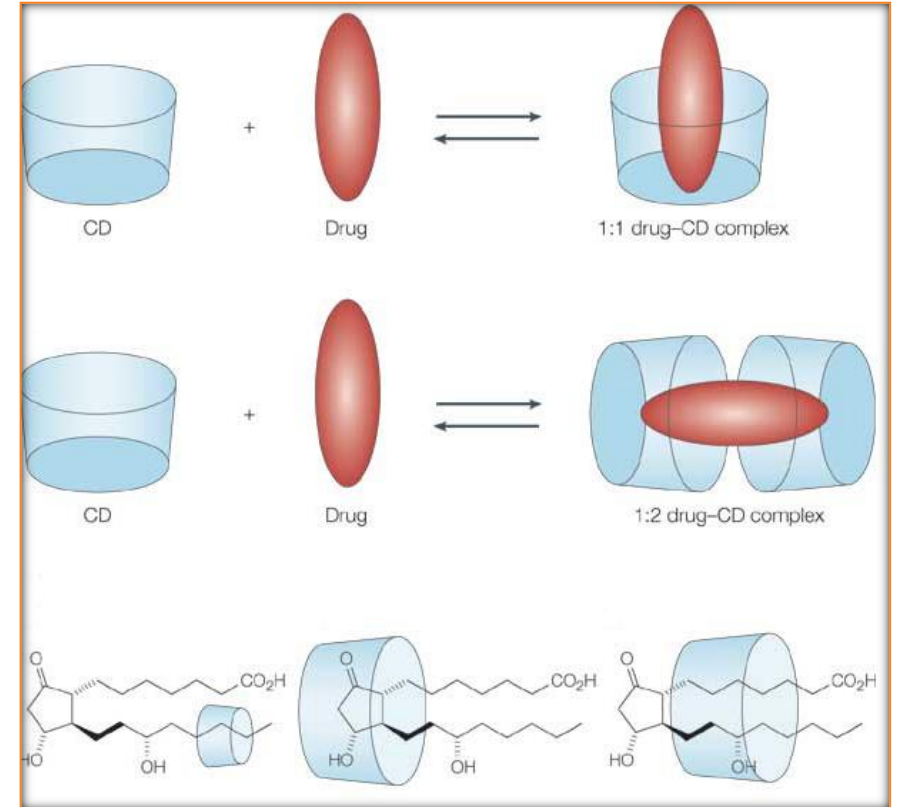
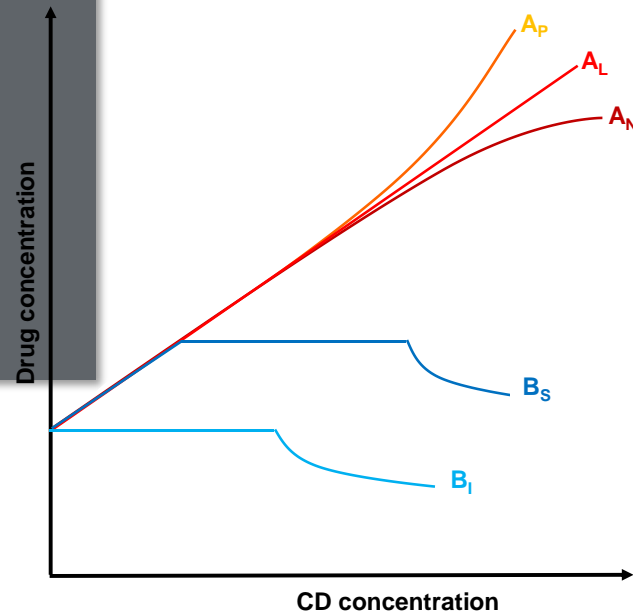
Isotherm type

Binding affinity (CD type)

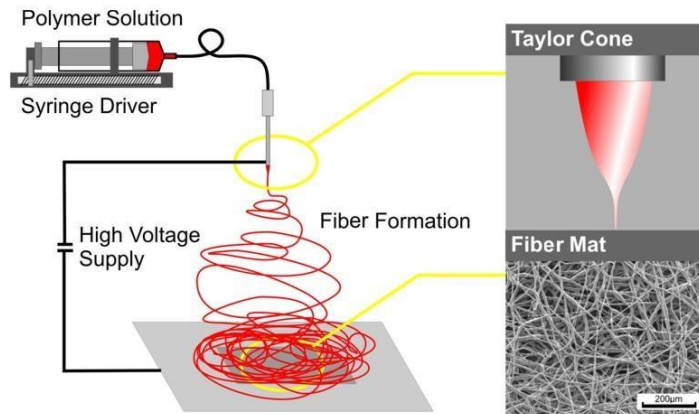
Dilution

Temperature

Competition



# Formulation technologies



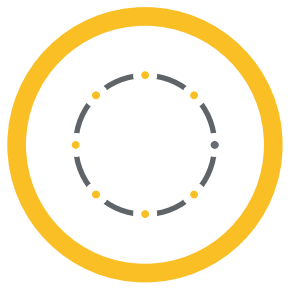
## Techniques for liquid formulations

Aqueous solutions  
Suspensions

## Techniques for solid complexes

Kneading method → Grinding  
Suspension method  
Co-evaporation  
Co-precipitation  
Electrospinning

Solid complexes are made from solutions, suspensions or slurry



# Using cyclodextrins in cosmetics

## CDs as solubilizing agents

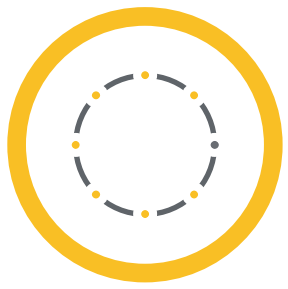
Stable aqueous solutions of insoluble compounds can be prepared without the use of organic co-solvents or surfactants and the rate of dissolution can be enhanced.

## Flavor and odor coverage by encapsulation

CDs may be useful in covering the unfavorable organoleptic characteristics of some cosmetic products due to the presence of a particular active.

## Liquid or oily materials can be transformed into powder forms

Some active ingredients in cosmetic preparations, such as  $\alpha$ -tocopherol and vitamin A, occur in oily form and thus are difficult to handle. This problem can be easily solved by preparing a CD inclusion complex in solid state.



# Using cyclodextrins in cosmetics

## Controlled/extended release of fragrances

CDs can be used to complex different fragrances, included in personal care products such as shampoos, deodorants, detergents and absorbent powders such as bath- and baby-powder products.

## Protecting agents against light, heat, and oxidation

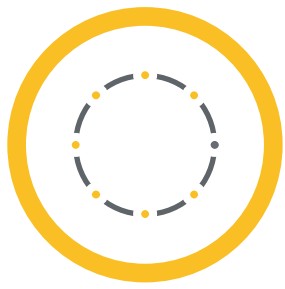
CDs can increase the physical and chemical stability of guest molecules by protecting them against oxidation, decomposition, hydrolysis or loss by evaporation.

## Preventing skin irritation

CDs alleviate local irritation and reduce side effects. CDs have advantages over other conventional penetration enhancers, such as fatty acids and surfactants.

## Stabilization of emulsions and suspensions

Incompatible compounds can be mixed and used together in complexed form.



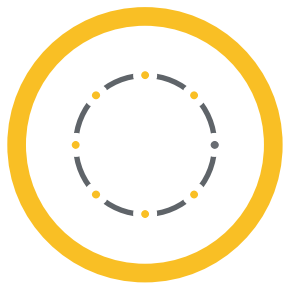
# Cyclodextrins in products

## Uses in cosmetics

- Solubilizing agents
- Flavor and odor coverage by encapsulation
- Liquid or oily materials can be transformed into powder forms
- Controlled/extended release of fragrances
- Protecting agents against light, heat, and oxidation:
- Protecting agents against light, heat, and oxidation:
- Stabilization of emulsions and suspensions

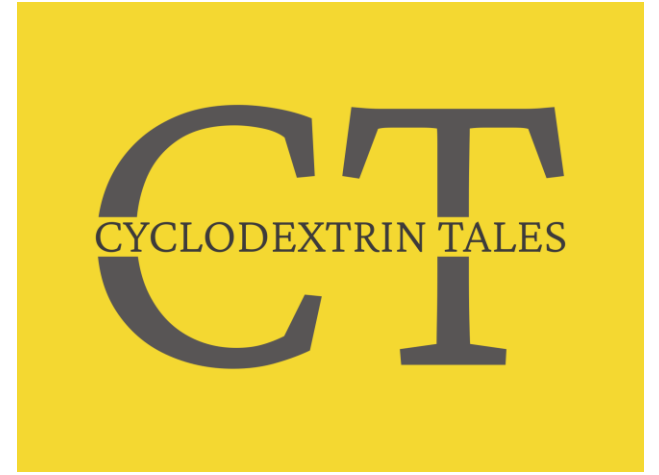






# Cyclodextrins in products

## Uses in cosmetics



- **Vitamin C serums:** Cyclodextrins are often used to stabilize and solubilize vitamin C in serums, which helps to improve its effectiveness in brightening and evening out the skin tone.
- **Retinol creams:** Cyclodextrins can help to protect retinol from degradation and improve its stability, which can lead to better anti-aging results in creams and lotions.
- **Essential oil hair treatments:** Cyclodextrins can be used to encapsulate essential oils in hair treatments, which can help to protect the oils from oxidation and improve their efficacy in nourishing and strengthening the hair.
- **Natural extract moisturizers:** Cyclodextrins can be used to solubilize and stabilize natural plant extracts in moisturizers, which can help to enhance their moisturizing and antioxidant properties.
- **Sunscreen formulations:** Cyclodextrins can be used in sunscreen formulations to encapsulate UV filters, which can help to improve their stability and reduce skin irritation.



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