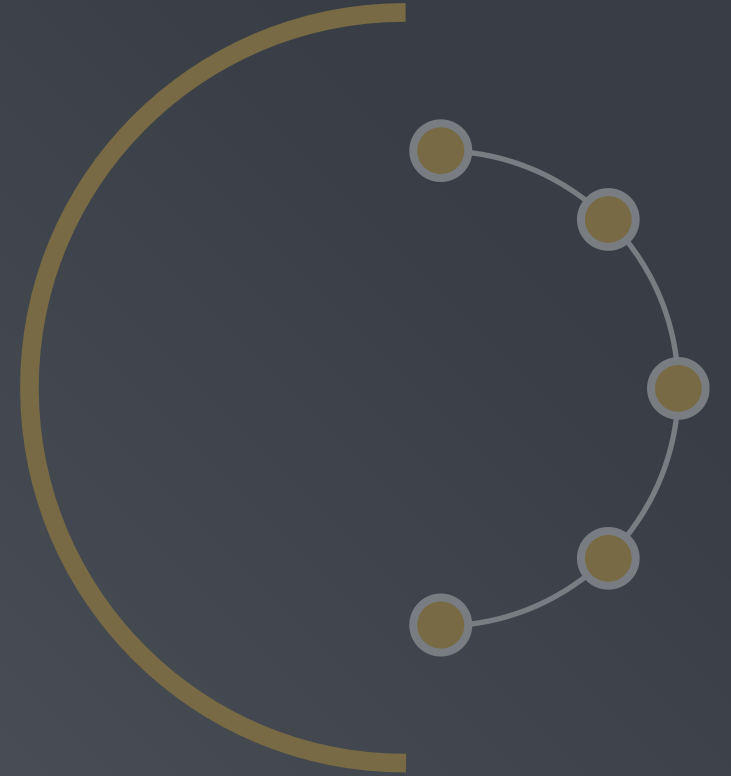


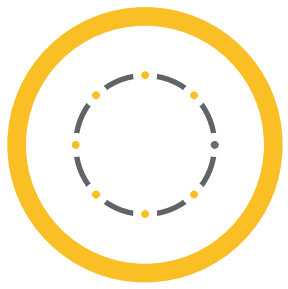


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Cyclodextrins

*Used for Cannabinoid Containing
Products*

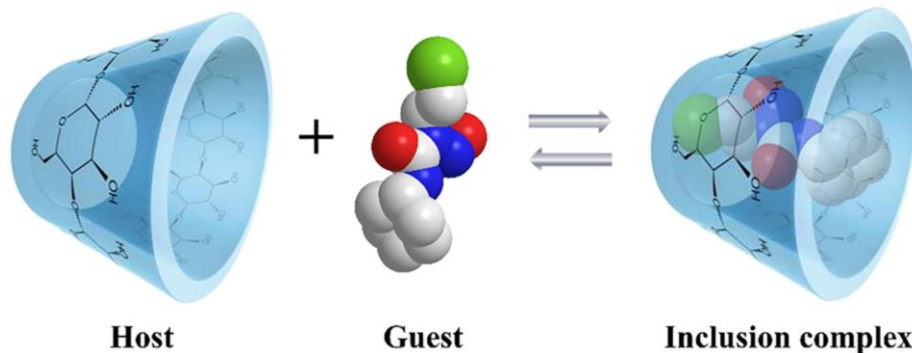




What are Cyclodextrins (CDs)?

Properties & applications

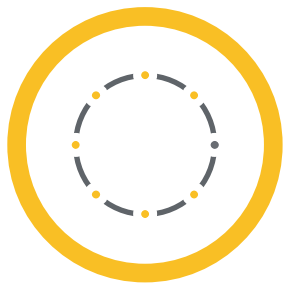
- Naturally occurring cyclic molecules, composed of sugars
- Toroid structure with **interior hydrophobic cavities** of 0.5 to 1.0 nm in diameter and **exterior hydrophilic rims**
- Diverse range of **applications**: food, pharmaceuticals, drug delivery, chemical industries, agriculture, etc.
- Often, the **aim** is to increase the solubility, dissolution rate, and stability of poorly soluble APIs.



CDs interact with drug molecules via dynamic complex formation



Application of CDs



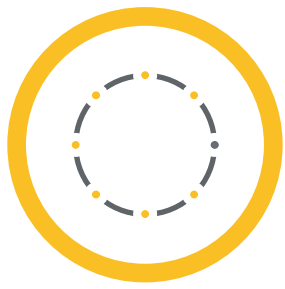
Marketed Pharma Products with CDs

100+ products on the market

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



	α -CD	β -CD	γ -CD	HP- β -CD	SBE- β -CD	RM- β -CD	HP- γ -CD
ORAL		X	X	X	X		
NASAL						X	
RECTAL		X		X			
DERMAL		X	X	X			
OCULAR		X		X	X	X	X
PARENTERAL	X			X	X		X



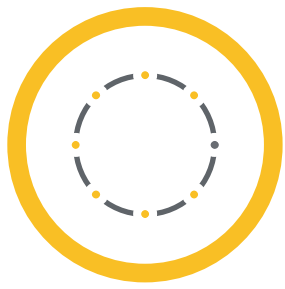
Formulations of Cannabinoids with Cyclodextrins

With cyclodextrin-based formulation, we can...

- Improve properties of endo-, phyto-, and synthetic cannabinoids by complexation
- **Increase the stability** of cannabinoids for longer shelf life and improved safety
- Convert **liquids and oily materials into powders** results in easier handling for more precise dosing
- Prepare **immediate-, or controlled-release** products with combinations of other excipients¹



...design systems to increase efficacy and reliability



CD-Containing Pharma Product

Epidiolex - FDA-approved CBD Oral Solution

Contains ethanol and sesame oil as a medium.

This can lead to patient **non-compliance**.

Solution for Solving CBD

CDs have been proven to increase the solubility and stability of cannabinoids.

Waterborne oral solutions and solid oral dosage forms can be prepared.¹



100 mg/mL CBD oil-based solution.

¹WO2021138597A1 Water-Soluble Cannabinoid Formulations and Methods of Their Making

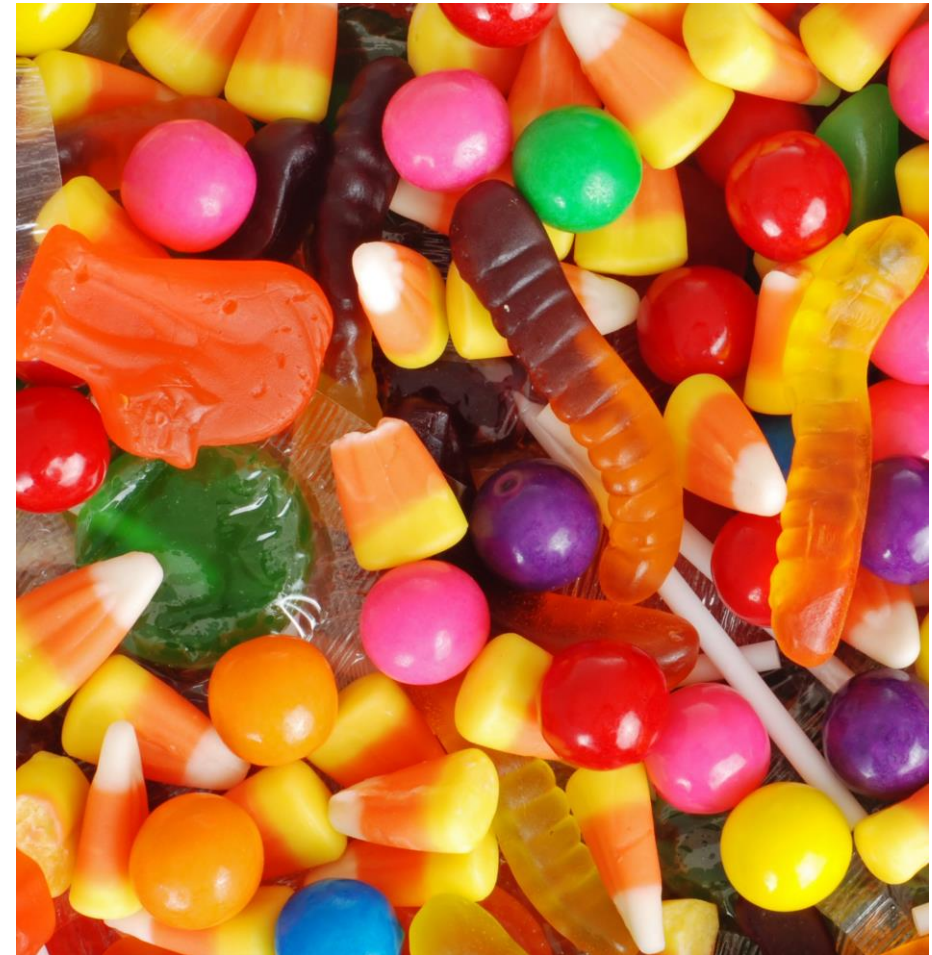


CD-Containing Food

Sweets

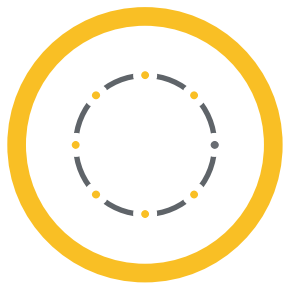
The CBD gummy market is expected to grow more than 28% from 2021 to 2028 and reach over \$12 million.¹

- CDs are used in gummies to enhance The perception of sweetness changing the firmness, or appearance of the gummies.
- CDs can also increase the solubility of CBD for easier handling



¹CBD Gummies Market Forecast to 2028 - COVID-19 Impact and Global Analysis By Category.
<https://www.theinsightpartners.com/reports/cbd-gummies-market>

²US2021401736A1 Semi-Solid Chewable Gel Cannabinoid Compositions and Methods of Making and Using Thereof



CD-Containing Dietary Supplement

Solubilized cannabinoids - cannabidiol (CBD)

Improved solubility and bioavailability of CBD.

α -CD is also listed for its benefits as a dietary supplement, as being able to lower cholesterol and blood-fat levels, while also feeding the gut microbiome.



Capsules containing a micelle preparation of water-soluble full-spectrum hemp oil powder.



Spectrum of products containing CD solubilized CBD

SUPPLEMENT FACTS		
SERVING SIZE: 1 CAPSULE		
SERVINGS PER CONTAINER: 10		
AMOUNT PER SERVING		% DAILY VALUE
Cyclodextrin Prebiotics	475 mgs	**
Cannabidiol (CBD) *	25 mg	**
(Derived from 200mgs full spectrum, whole plant hemp oil including all natural Cannabinoids and Terpenes.)		



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CRO - FORMULATION SERVICES

Unlocking the potential of your API with cyclodextrin-based formulation

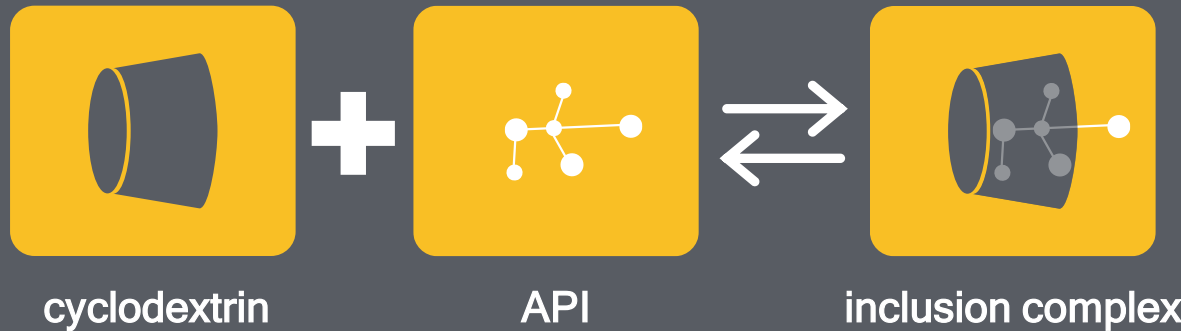
With cyclodextrins we can increase
your API's

- Solubility
- Stability
- Wetting, dissolution rate
- Absorbed quantity



With cyclodextrins we can decrease
your API's

- Dose for same efficacy
- Taste
- Side effects
- Smell



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