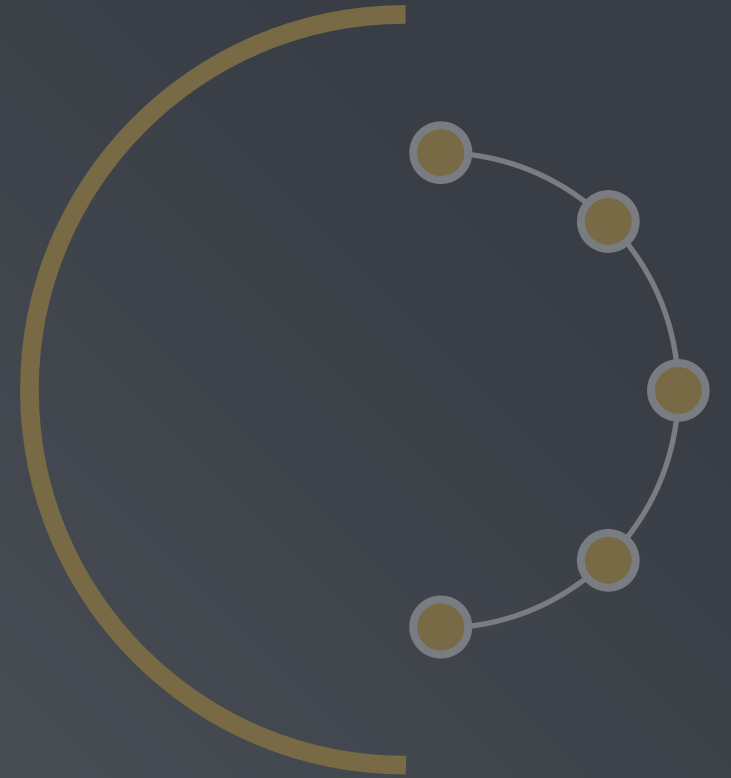


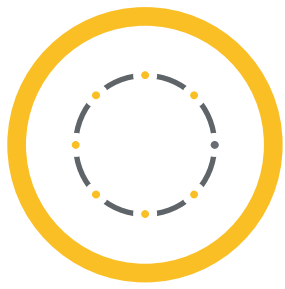


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# Cyclodextrins

*Cyclodextrins in Food and Nutrition*



# What are Cyclodextrins (CDs)?

## Properties & applications

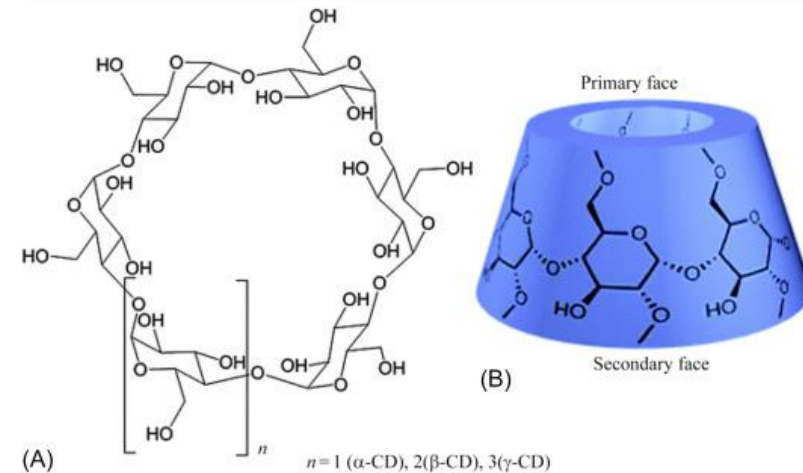
- Composed of sugars
- Naturally occurring cyclic molecules
- Used in food, pharmaceuticals, drug delivery, chemical industries, agriculture, etc.
- Sub-nanometer sized molecular containers with hydrophilic outer phase and hydrophobic interior properties
- Reversible inclusion complex formation

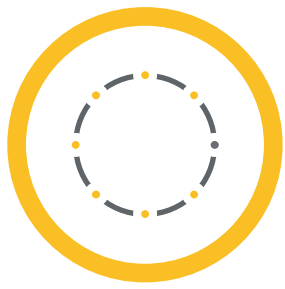
## CDs with GRAS<sup>1</sup> status

- alfa-cyclodextrin
- beta-cyclodextrin
- gamma-cyclodextrin

<sup>1</sup>Generally recognized as safe (GRAS)

## Structure and application of CDs





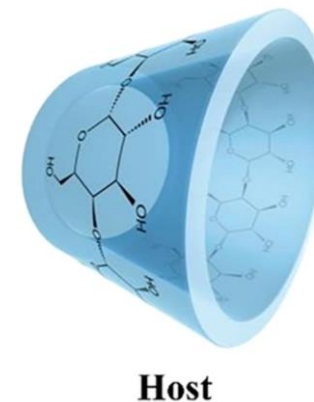
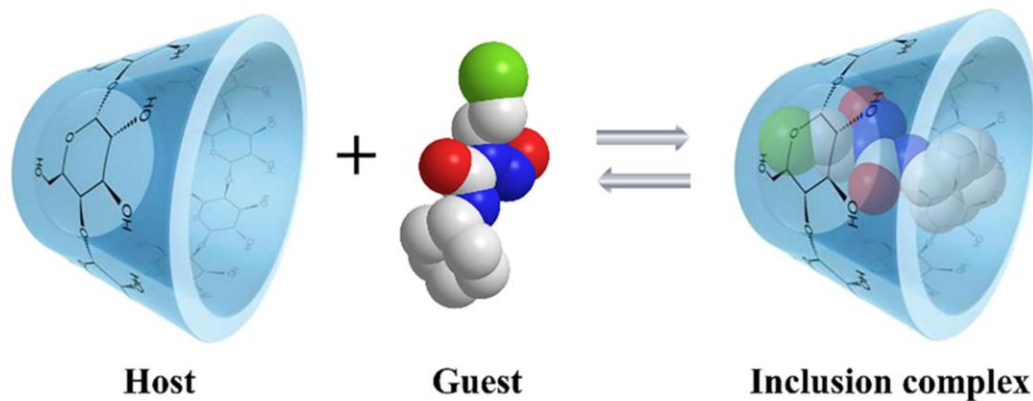
# Utility of Cyclodextrins in Food

## Encapsulation agents/additive

- **stabilization** of flavours, colorants, etc.
- **solubilization** purposes (beverages)
- **controlled-release** of food additives
- **improving food properties** (against hygroscopicity, improving powder properties, etc.)

## „Empty” non-complexed CDs

- **tastes and odor masking** agents
- **dietary fibers**, affecting human microflora
- human **lipid status-altering** agents
- **glycemic response** affecting agents





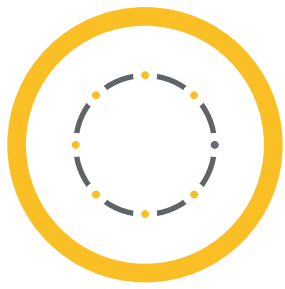
# Utility of Cyclodextrins in Food

## Solubilizing in foods

CD-complexation **improves the solubility** of lipophiles

Example: prevention of precipitation, aggregation in canned juices, Citrus beverages (hesperidin, naringin, etc.), food lipids: fats, sterols, carotenes





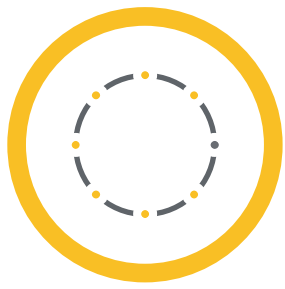
# Cyclodextrin-Enabled Packaging Materials

## Absorber and emitter functions



**CD complexed volatiles:** in emitting sachets and bags to provide released volatile antimicrobials, repellents etc. (moisture-activated!)

**Empty CDs:** in adsorbent pads and bags (collecting, fixing and immobilizing odours and to prevent loss of volatiles)



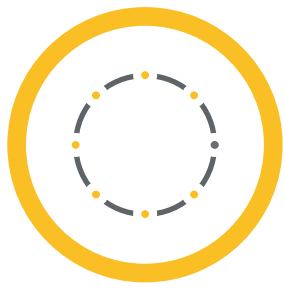
# CD Additive to Improve the Quality of Starchy Food

## CDs in rice, noodles and other starchy foods

- Dietary fiber
- Improved taste
- Anti-aging effect (reduced retrogradation of starch)
- Improved palatability
- Longer shelf-life
- Reduced glycemic index
- Lower insulinemic effect



**EFSA recommendation:** to consume at least 5 g of  $\alpha$ -CD to each 50 g of starch to achieve considerable reduction of post-prandial glycemic responses



# Cholesterol Removing and Egg-Free Baking

## Cholesterol-removal process from eggs

- **Step 1** yolks and whites are separated
- **Step 2** beta-CD is mixed with the yolks and then products are removed, along with the crystalline cholesterol-BCD complex by centrifugal force
- **Step 3** yolks and whites rejoined
- **Step 4** the mixture is pasteurized

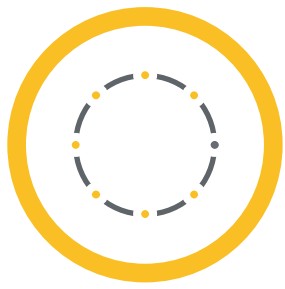


## Egg-free baking

- Alpha-CD can create oil-in-water **emulsions** that remain **stable, even at high temperatures**
- replace up to 100% of eggs in ready-to-use powder mixes.
- plant-based soluble dietary fiber
- vegan, kosher & halal
- free of all major allergens
- easy to process (powder mixes)



Enables producers to utilize a streamlined HACCP approach while also offering a safeguard against fluctuations in seasonal egg prices.



# CD-Containing Dietary Supplement

Solubilized cannabinoids - cannabidiol (CBD)

Contains 25 mg CBD per capsule  
475 mg  $\alpha$ -cyclodextrin.

Improved solubility and bioavailability.

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

Spectrum of products containing CD solubilized CBD.



## SUPPLEMENT FACTS

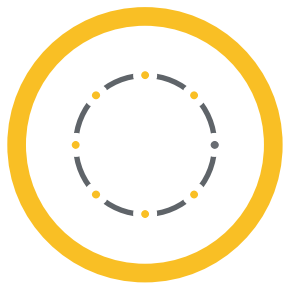
SERVING SIZE: 1 CAPSULE

SERVINGS PER CONTAINER: 10

AMOUNT PER SERVING		% DAILY VALUE
Cyclodextrin Prebiotics	475 mg	**
Cannabidiol (CBD) *	25 mg	**

(Derived from 200mg full spectrum, whole plant hemp oil including all natural Cannabinoids and Terpenes.)





# New Seasoning Concept

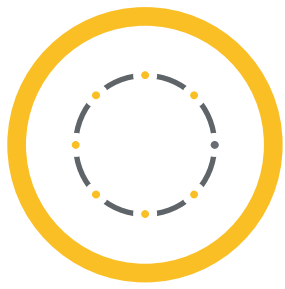
Designed to improve not the "taste" but your "body"

- Tasteless and odorless
- Simple to use, just sprinkle it on food
- CD efficiently captures excess fats and inhibits their absorption
- Improve both health and flavours

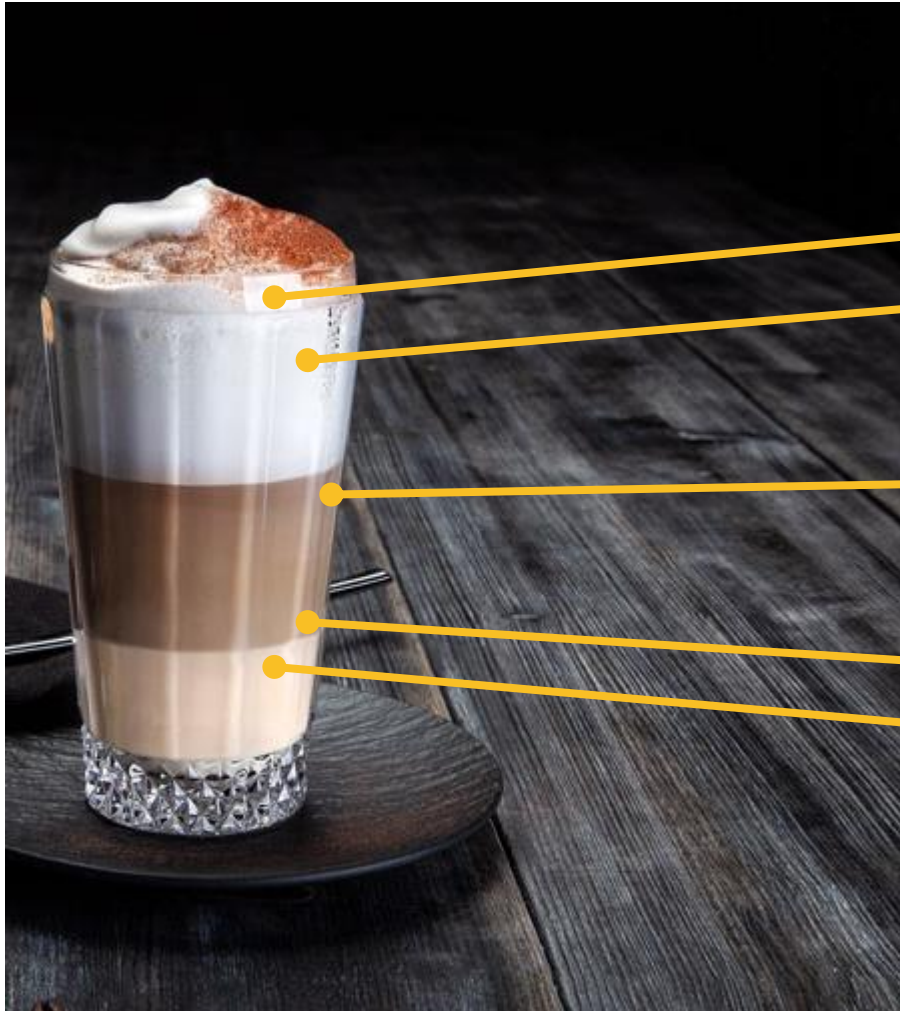
**Cyclodextrin (CD) traps fats, and inhibits their absorption.**



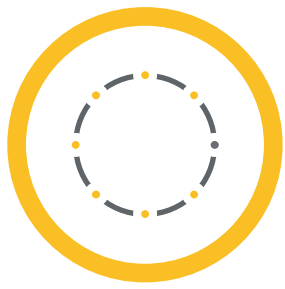
DON-MAIN salt, pepper and chili seasoning produced by CyDing Co., Ltd.



# An Example for Cyclodextrin Utility in One Product



- Long-lasting, high volume foam
- Cholesterol reduced milk
- Coffein reduced coffee
- Masking bitterness of coffee
- Encapsulation of acids for enriching antioxidant capacity



# Utility of Cyclodextrins in Food

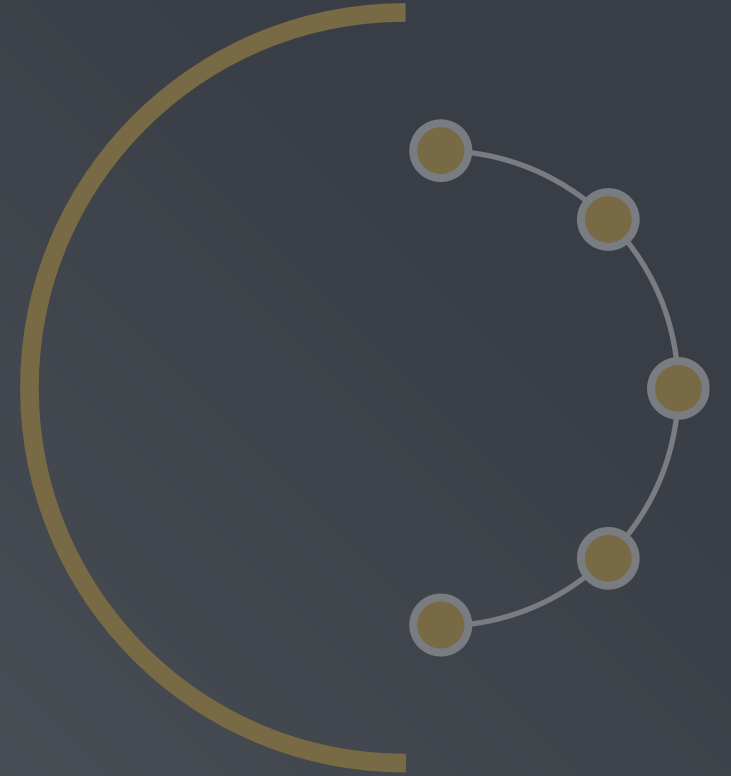
The possibilities are...

- **Soft drinks and carbonated beverages**  
(encapsulate flavorings, such as fruit flavors, to improve their stability and taste)
- **Bakery products**  
(improve the texture and shelf life of baked goods, such as bread and cakes)
- **Dairy products**  
(encapsulate vitamins, to improve their bioavailability in dairy products, such as yogurt and cheese)
- **Chewing gums**  
(encapsulate flavorings and sweeteners, such as peppermint and aspartame, to improve their stability and taste)
- **Nutraceuticals and dietary supplements**  
(improve the stability and bioavailability of vitamins, minerals, and other active ingredients in dietary supplements)
- **Sports drinks**  
(encapsulate carbohydrates, such as glucose and fructose, to improve their stability and slow their absorption into the bloodstream, providing sustained energy during exercise)

...endless.



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## Company Contacts

CARBOHYDE

**E-mail:** [info@carbohyde.com](mailto:info@carbohyde.com)  
[balazs.kondoros@carbohyde.com](mailto:balazs.kondoros@carbohyde.com)

**Web:** <http://www.carbohyde.com>