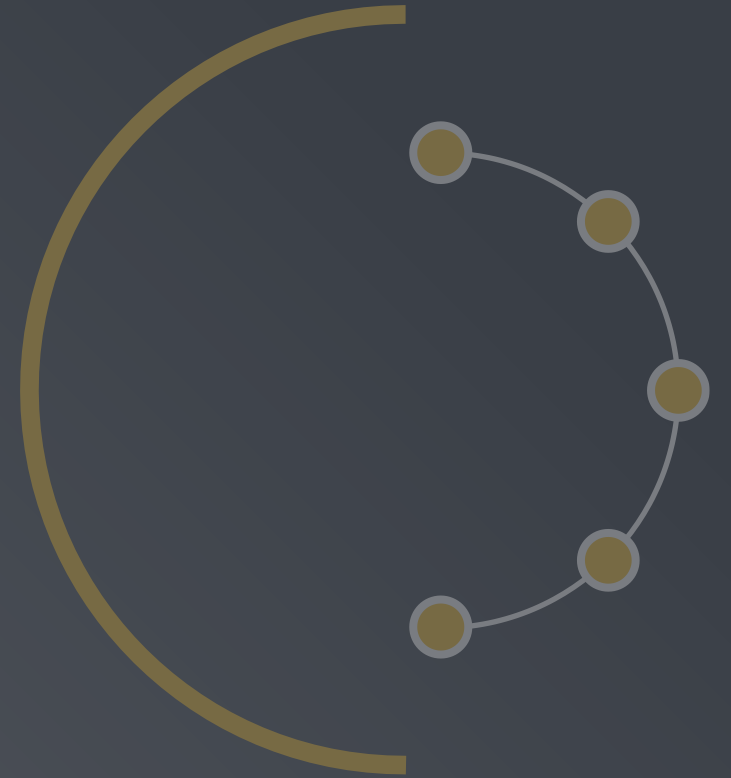


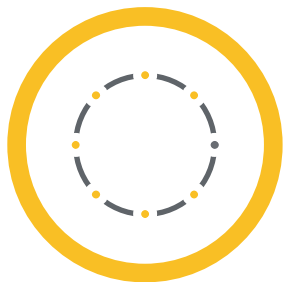


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# Cyclodextrins

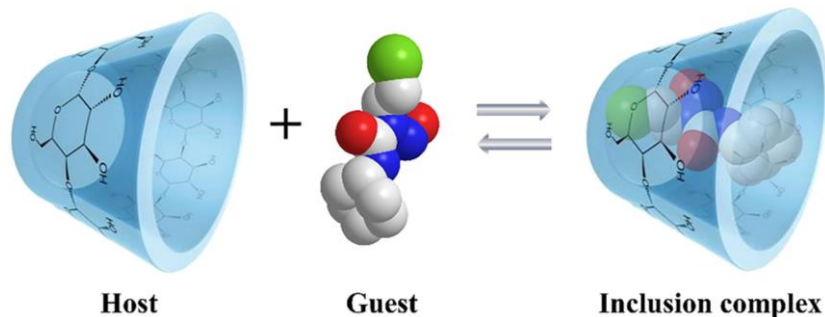
*In Veterinary Products*



# What are Cyclodextrins (CDs)?

## Properties

- Natural, cyclic molecules, composed of sugars.
- Toroid structure with **interior hydrophobic** cavities and **exterior hydrophilic** rims.
- Hydrophobic molecules can be incorporated.
- Often, the **aim** is to increase the solubility, dissolution rate, and stability of poorly soluble APIs.



Dynamic host-guest interaction



Medicine:  
Human and  
Veterinary



Household



Food &  
Drinks

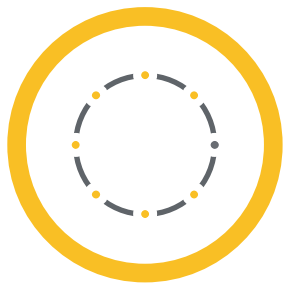


Agriculture



Cosmetics

The structure and application areas of CDs



# A Powerful Tool in Traditional Application

## CDs as multifunctional excipients

CDs as drug complexing agents in drug delivery

Nanosizing, solubilizing, stabilizing, etc.

With cyclodextrins we can **increase** your API's

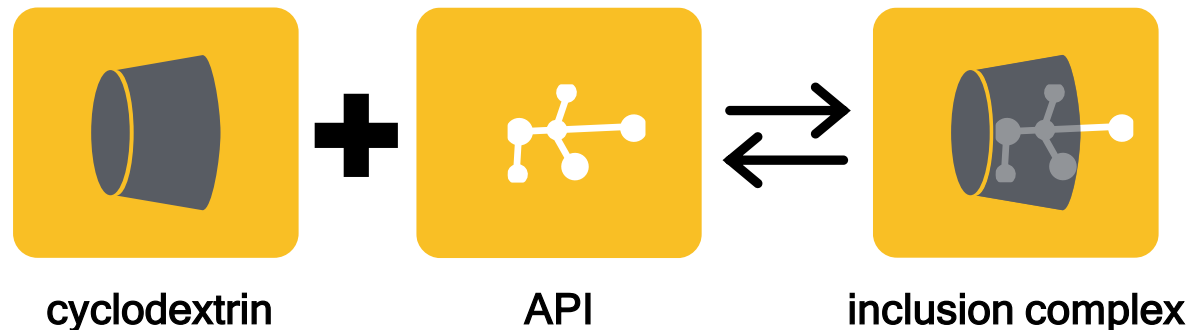


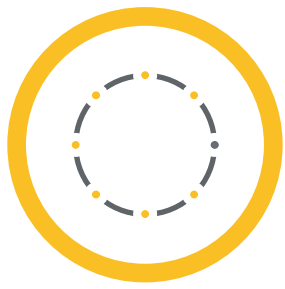
- Solubility, dissolution rate
- Stability
- Wetting
- Absorbed quantity, bioavailability

With cyclodextrins we can **decrease** your API's



- Dose for the same efficacy
- Taste and smell
- Drug-drug or drug-excipient interactions
- Toxicity, side effects





# Cyclodextrins in Veterinary Products



Injection  
for cats, dogs, other pets  
Alphaxalone (Alfaxan)  
HPBCD



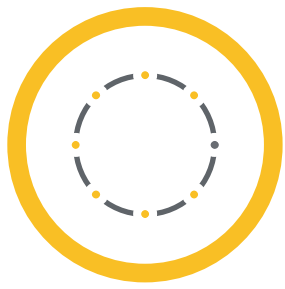
Tablets  
for dogs  
Maropitant (Cerenia)  
SBEBCD



Injection  
for cats and dogs  
Maropitant (Prevomax)  
SBEBCD



Oral solution  
for cats  
Itraconazol (Itrafungol)  
HPBCD



# Cyclodextrins in Vaccines

## Key considerations: human and veterinary

- Cyclodextrins have emerged as promising stabilizers for vaccines, ensuring the **preservation of their immunogenicity**.
- Cyclodextrins can **protect antigens** by forming inclusion complexes and shielding them from degradation factors such as light, heat, and enzymatic activity.
- This stabilization approach has been explored for various vaccines, including protein-based vaccines, viral vector vaccines, and subunit vaccines, improving their shelf life and efficacy.
- In human application it is also used as a **cryopreservative** (e.g., Covid-19 vaccine J&J ad26.cov2.s) by encapsulating and shielding sensitive biomolecules and maintaining the osmotic balance.
- Daichii Sankyo's HPBCD-adjuvanted live attenuated influenza **vaccine nasal spray** is on the market.
- Pharmaceutically accepted CDs and derivatives in human parenteral formulations:
  - $\alpha$ -CD
  - Hydroxypropyl- $\beta$ -cyclodextrin (HPBCD)
  - Sulfobutylether- $\beta$ -cyclodextrin (SBE- $\beta$ -CD)



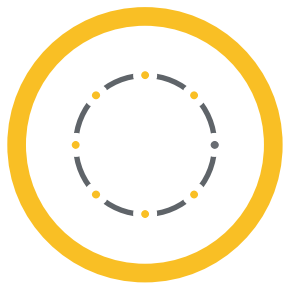
# Cyclodextrins in Vaccines - Adjuvants

## Sulfolipo CD - Suvaxyn

- Suvaxyn PCV™ contains inactivated recombinant Porcine Circovirus type 1, expressing the Porcine Circovirus type 2 ORF2 protein. This vaccine is used for the active immunization of pigs over the age of 3 weeks against Porcine Circovirus type 2 (PCV2).
- Sulfolipo-cyclodextrin is used as an adjuvant.



Vaccine containing sulfolipo-CD against Porcine Circovirus for veterinary use



# Cyclodextrins in Vaccines - Adjuvants

## HPBCD - Cevac BI L

- Cevac BI L Live freeze-dried vaccine, Massachusetts B48 and Hitchner B1 strains for the active immunization of chickens against Newcastle Disease and Infectious Bronchitis.
- HPBCD is used as an adjuvant.

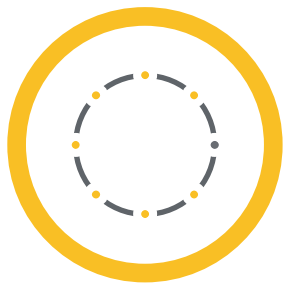


Live freeze dried vaccine, Massachusetts, B48 and Hitchner B1 strains

For the active immunization of chickens against Newcastle Disease and Infectious Bronchitis



Vaccine containing HPBCD against Newcastle disease for veterinary use



# Cyclodextrins in Veterinary Therapy

## Scientific literature

These 3 tables contain some of the current and potential future clinical applications of inclusion complexes in veterinary medicine.<sup>1</sup>

	Active Compound	Treated Species	CD Types
NSAIDs/SAIDs	Ketoprofen	horse, cattle, sheep and goats, pigs	β-CD
	Tolfenamic acid	cattle, pig, dog and cat	HPBCD
	Meloxicam	dog, cat and cattle	β-CD
	Carprofen	dog, cat and cattle	HPBCD
	Dexamethasone	all animal species	HPBCD
	Methyl-prednisolone	large and small animals	β-CD, γ-CD

	Active Compound	Treated Species	CD Types
Antifungal drugs	Flucytosine	dog and cat	β-CD, HPBCD
	Sulconazole nitrate	dog	β-CD
	Voriconazole	dog, rarely in cat, many wildlife species, etc.	HPBCD, SBEB CD, γ-CD
	Itraconazole	dog, horse, bird, small mammals, and reptiles.	β-CD, HPBCD

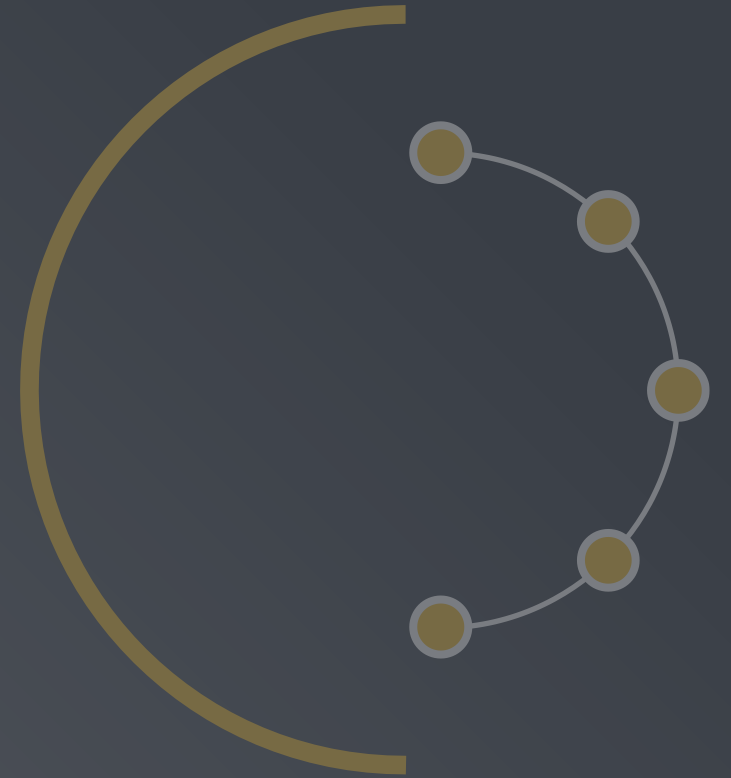
	Active Compound	Treated Species	CD Types
Antibacterial drugs	Enrofloxacin	all animal species	γ-CD
	Florfenicol	cattle, sheep and pigs	HPBCD
	Amoxicillin	all animal species	HPBCD
	Gentamicin sulphate	horse, foal, cattle, calf, pig, dog, cat	β-CD
	Metronidazole	dogs and cats	HPBCD

<sup>1</sup>Greco M, et al. Short Review on the Biological Activity of Cyclodextrin-Drug Inclusion Complexes Applicable in Veterinary Therapy. *Molecules*. 2023 Jul 21;28(14):5565.





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