CARBOHYDE
REVOLUTION OF
CYCLODEXTRINS

Cyclodextrins

In Veterinary Products

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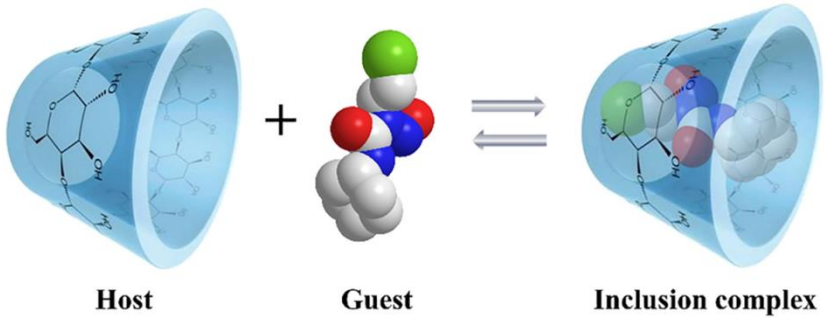
What are Cyclodextrins (CDs)?

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

The structure and application areas of CDs

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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

cyclodextrin API inclusion complex

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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

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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:
    - α-CD
    - Hydroxypropyl-β-cyclodextrin (HPBCD)
    - Sulfobutylether-β-cyclodextrin (SBE-β-CD)

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Cyclodextrin in Chewable Tablets

Anxitane® - for cats and dogs

- Contains L-theanine from green tea concentrate.
- Supplementary feed, can help reduce stress-related reactions.
- Formulation: chewable tablet.
- Excipient: gamma-CD (among others)

Supplementary feed containing gamma-CD

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Cyclodextrin in Subcutaneous Injection

Ipecon® - for cats

- Contains antiviral nucleoside analogue drug.
- Developed for the treatment of feline infectious peritonitis.
- Formulation: freeze-dryed powder for sc. Injection.
- Sulfobutylether-beta-CD (SBECD): solubilizer.[1]

Veterinary product containing SBECD as excipient

[1] Russian Patent No. 2791737C1

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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

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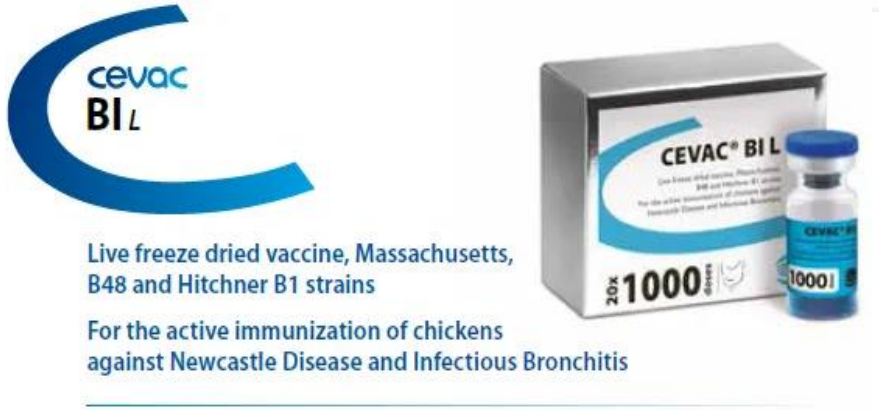
Cyclodextrins in Vaccines - Adjuvants

HPBCD – Cevac BI L

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



Vaccine containing HPBCD against Newcastle disease for veterinary use

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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.[1]

	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, SBEBCD, 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

[1]Grecu 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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For any questions:

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