

**CYCLOLAB**



*The Cyclodextrin Company*

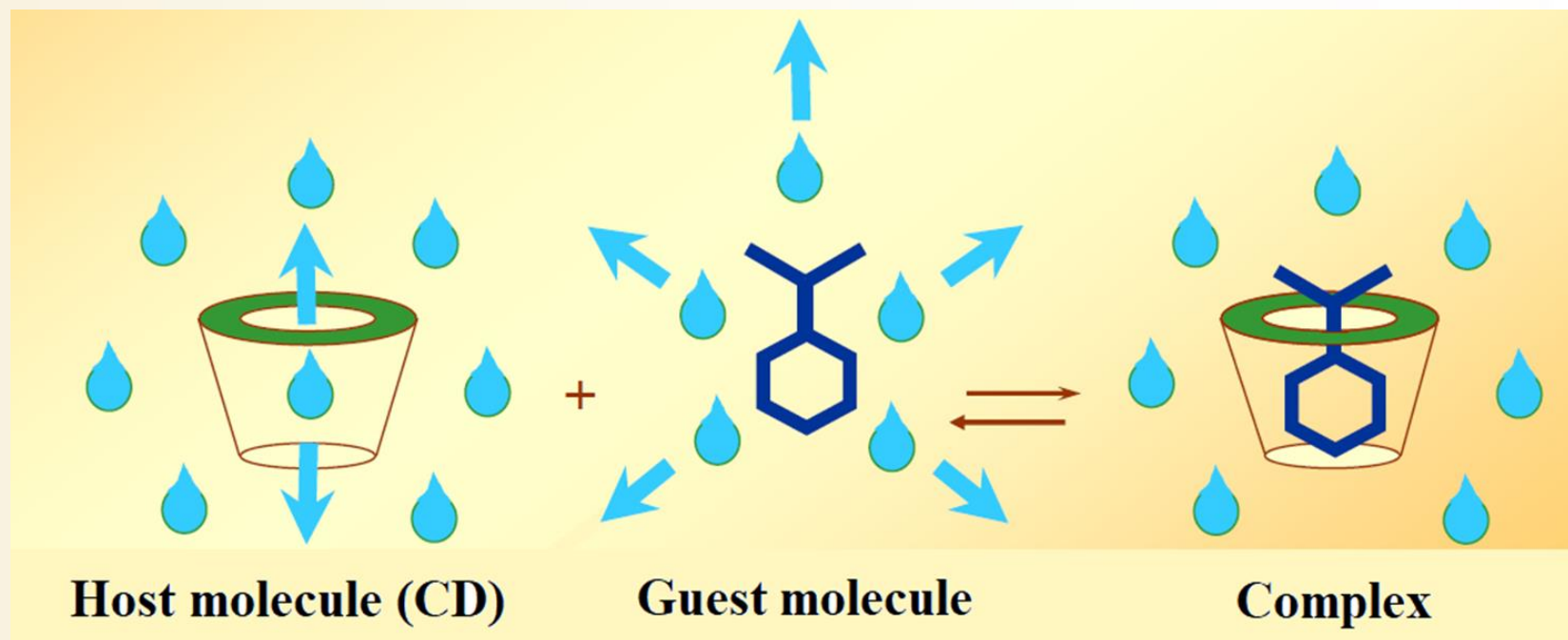


# **Cyclodextrins in *veterinary* use**



# What are cyclodextrins (CDs)?

- **Composed of sugars**
- **Cyclic molecules**
- **Naturally occurring compounds**
- **Used in food, pharmaceuticals, drug delivery, chemical industries, agriculture, etc.**



## Why use cyclodextrins?



- **Significant solubility enhancement**
- **Improvement of chemical stability**
- **Increased bioavailability, facilitated delivery**
- **Reduced aggregation**
- **Moderated irritation or reduced side-effects**
- **Maximized safety, complete renal elimination**
- **Enables formulation of water-insoluble APIs in all dosage forms**
- **Lower API doses can be achieved**
- **Potential antidote for organophosphate poisonings**



The Cyclodextrin Company

## Who we are and what can we offer?

**CycloLab is the world's only all-around Cyclodextrin Service Provider**

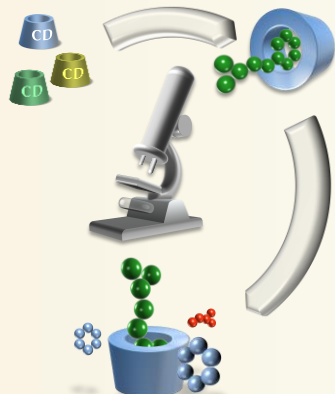
**Our services include:**

- **Supplying cyclodextrins for commercial products and product development**
- **Screening cyclodextrin derivatives to find the right candidate for target API.**
- **Providing formulation development services, composition optimization, stability assessment.**
- **Offering analytical services to characterize complexes and products.**
- **Preparing pilot-scale amounts for cyclodextrin-API complexes under GMP for development purposes.**
- **Assisting in compilation of regulatory documentation.**

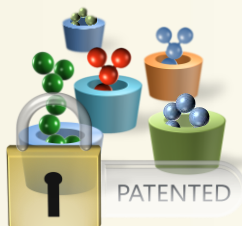
**For more information please click [here](#)**



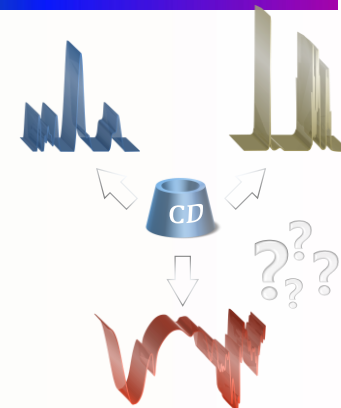
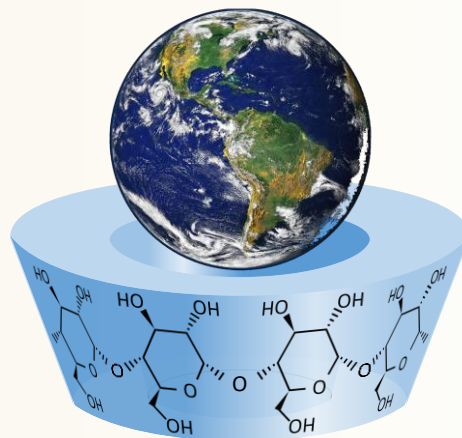
# What is CycloLab?



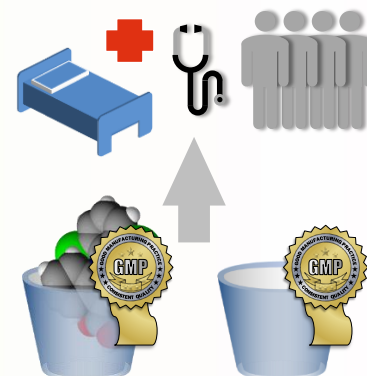
**Early phase drug development**



**IP services & consultancy**

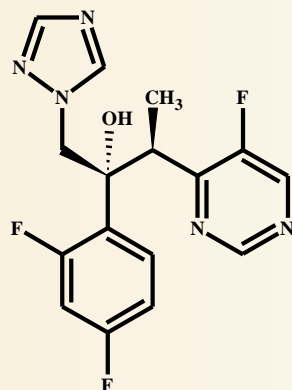


**Analytical services**

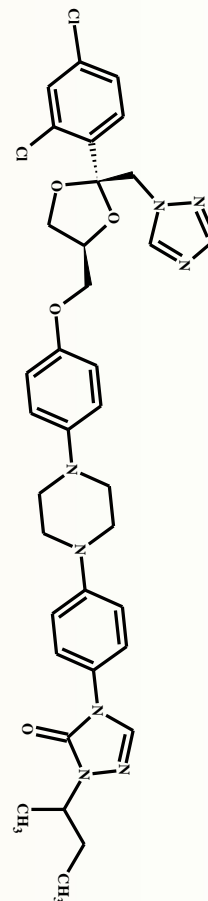


**GMP synthesis and production**

## Antifungal agents



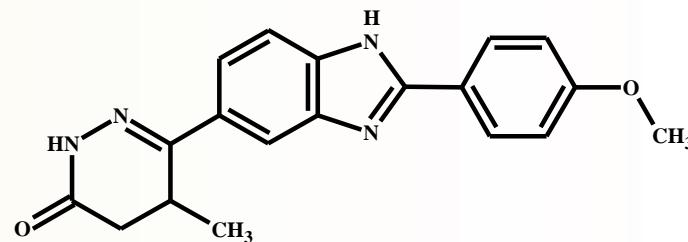
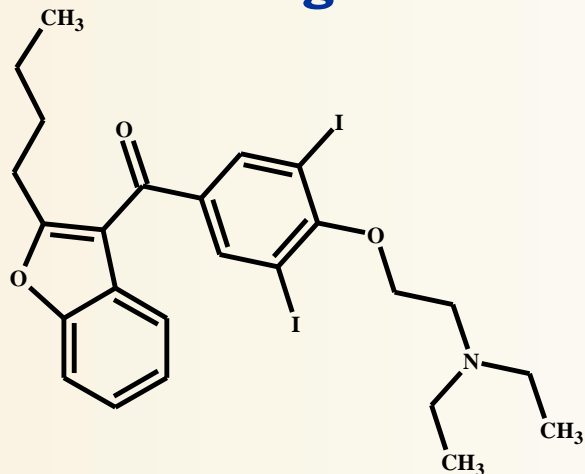
- **Voriconazole** is an antimycotic drug for both human and veterinary use.
- In the formulation, *sulfobutyl-ether-beta-cyclodextrin (Dexolve™)* is used as an excipient.



- **Itraconazole** (Itrafungol™), it is used as antimycotic drug in cats.
- In the formulation, *(2-hydroxypropyl)-beta-cyclodextrin* is used as an excipient.



## Drugs affecting the cardiovascular system



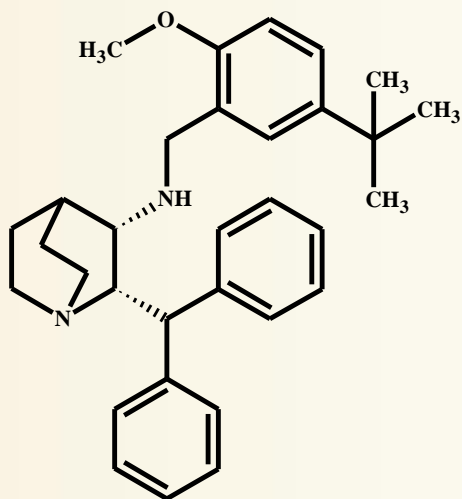
- **Amiodarone** is an antiarrhythmic drug. It has several indications, and it is used in humans and in veterinary medication.

- A new formulation (Nexterone™, PM101) contains *sulfobutyl-ether-beta-cyclodextrin* as a solubilizing agent instead of Polysorbate 80.

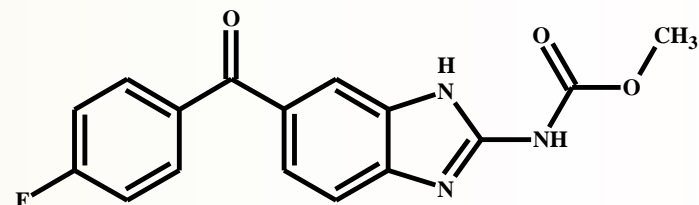
- Does not cause hypotension
- Safe for bolus administration
- Plastic-friendly allows for prefilled non-glass syringes in future
- Currently FDA-approved only in glass syringe

- **Pimobendan** (Vetmedin™), is a calcium sensitizer and a selective inhibitor of phosphodiesterase 3 (PDE3) with positive inotropic and vasodilator effects, used for the treatment of heart failure in dogs.
- A new patent by Boehringer Ingelheim describes a formulation that consists of modified *cyclodextrins*<sup>1</sup>.





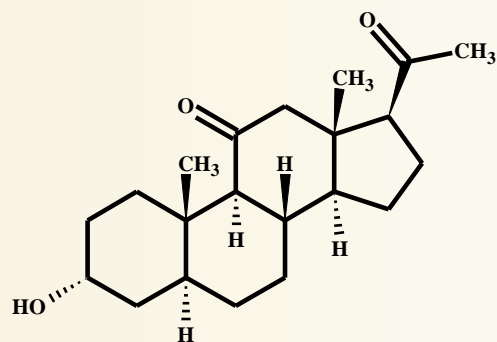
- **Maropitant** (Cerenia™), a drug used for the treatment of motion sickness and vomiting in dogs.
- In the formulation, *sulfobutyl-ether-beta-cyclodextrin* is used as a solubilizing agent.



- **Flubendazole** is an antihelmintic drug, used both in veterinary and human medication.
- *(2-hydroxypropyl)-beta-cyclodextrin* can be used as a solubilizing agent, to improve water solubility<sup>2</sup>.







• **Alfaxalone** (Alfaxan™), is a neuroactive steroid molecule with general anesthetic effects. It is used only in veterinary practice.

• In the formulation, *(2-hydroxypropyl)-beta-cyclodextrin* is used as a solubilizing agent



## Cyclodextrins are also used in vaccines



Live freeze-dried vaccine,  
Hitchner B1 strain

For the active immunization of chickens  
against Newcastle Disease



As an excipient , *(2-hydroxypropyl)-beta-cyclodextrin* is used.

- Suvaxyn PCV <sup>TM</sup> 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 (SLCD)* is used as an adjuvant

# Other possibilities for cyclodextrin usage

## Vitamins and cyclodextrins<sup>3</sup>

- **$\beta$ -cyclodextrins** improve pharmacokinetics of  $\alpha$ -tocopherol in heifers<sup>3</sup>
- Cyclodextrin encapsulated vitamin K ( $K_1$ ,  $K_2$ ) can reduce osteochondral effects in animals<sup>4</sup>

## Essential oils and cyclodextrins

Several patents are about essential oil formulations with cyclodextrins<sup>5</sup>, e.g.:

- Camphor oil (-respiratory stimulant<sup>6</sup>)
- Lemon oil (-flavor enhancer)
- Cinnamon oil (-flavor enhancer)
- Garlic oil (-antimicrobial)

## Cryopreservation

- Cholesterol-loaded cyclodextrins can prevent cryosurvival of animal sperms<sup>7,8</sup>
- Cholesterol-loaded cyclodextrins improve quality of stallion spermatozoa<sup>9</sup>

## Effects of cyclodextrin complexes on methane production in heifers<sup>10</sup>

- The  **$\beta$ -cyclodextrin** complex with guest materials appears to be a promising solution to mitigate methane emissions without reducing energy intake.

<sup>3</sup> Bontempo V. et al. Kinetic behavior of three preparations of  $\alpha$ -tocopherol after oral administration to postpubertal heifers, *American Journal of Veterinary Research*, 2000, 61(5):589-93

<sup>4</sup> Nibiffin JR and Regtop H, Method for increasing bone density and/or reducing any osteochondral defects in an animal and a composition including vitamin K, 2015, US 8999962 B2

<sup>5</sup> Geetika W. et al., Essential oil-cyclodextrin complexes: an updated review, *Journal of Inclusion Phenomena and Macrocyclic Chemistry*, 2017, 89(1):39-58

<sup>6</sup> <https://www.drugs.com/vet/camphor-injection-can.html>

<sup>7</sup> E. Mocé and J. K. Graham, Cholesterol-loaded cyclodextrins added to fresh bull ejaculates improve sperm cryosurvival, *Journal of Animal Sciences*, 2005, 84(4):826-833

<sup>8</sup> Chuaychu-Noo N et al., Supplementing rooster sperm with Cholesterol-Loaded-Cyclodextrin improves fertility after cryopreservation, *Cryobiology*, 2017, 74:8-12

<sup>9</sup> Moraes EA et al., Cholesterol-loaded-cyclodextrin improves the quality of stallion spermatozoa after cryopreservation, *Animal Reproduction Science*, 2015, 158:19-24

<sup>10</sup> Rajaraman B et al., Effects of caprylic acid and  $\beta$ -cyclodextrin complexes on digestibility, energy balance, and methane production in Korean Hanwoo heifers, *Animal Feed Science and Technology*, 2017, 234:72-77



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