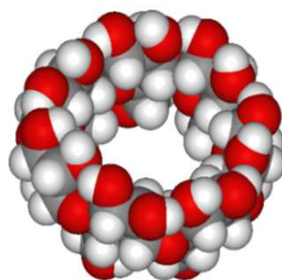




The Cyclodextrin Company

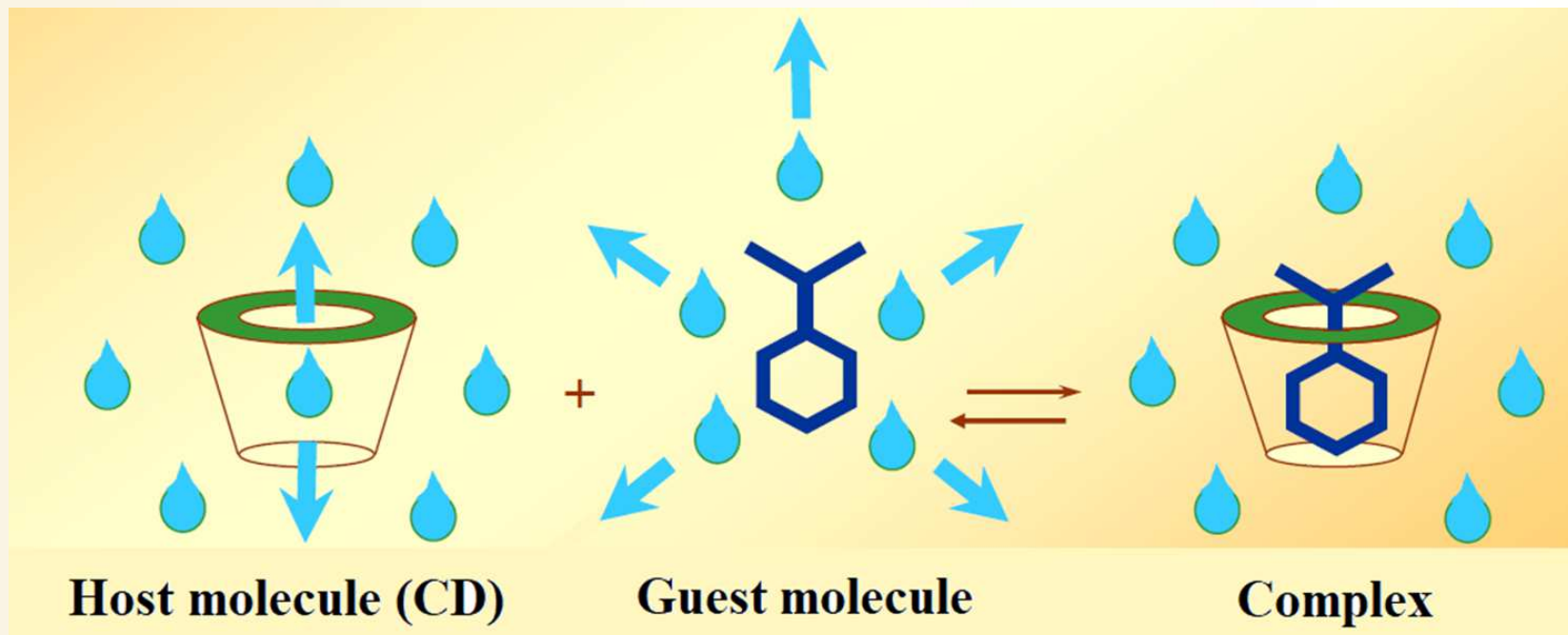


Cyclodextrins in *biotechnology*



What are cyclodextrins (CDs)?

- Composed of sugar units
- Cyclic, doughnut-shaped molecules
- Naturally occurring compounds produced from plants (no animal origin!)
- Used in food, pharmaceuticals, drug delivery, chemical industries, agriculture, etc.



Reversible inclusion complex formation

Why use cyclodextrins?

- CDs enhance the solubility of complexed substrates (substitute detergents and co-solvents)
- CDs do not damage the microbial cells or the enzymes
- CDs intensify the enzymatic conversion of lipophilic substrates
- CDs improve the yield of product-inhibited fermentations
- Organic toxic compounds are tolerated by microbes in higher concentrations
- Compounds in small amounts can be isolated simply from complicated mixtures
- CDs complexes can substitute for mammalian serum in tissue cultures
- Unstable and/or insoluble proteins can be dissolved and stabilized in aqueous solution

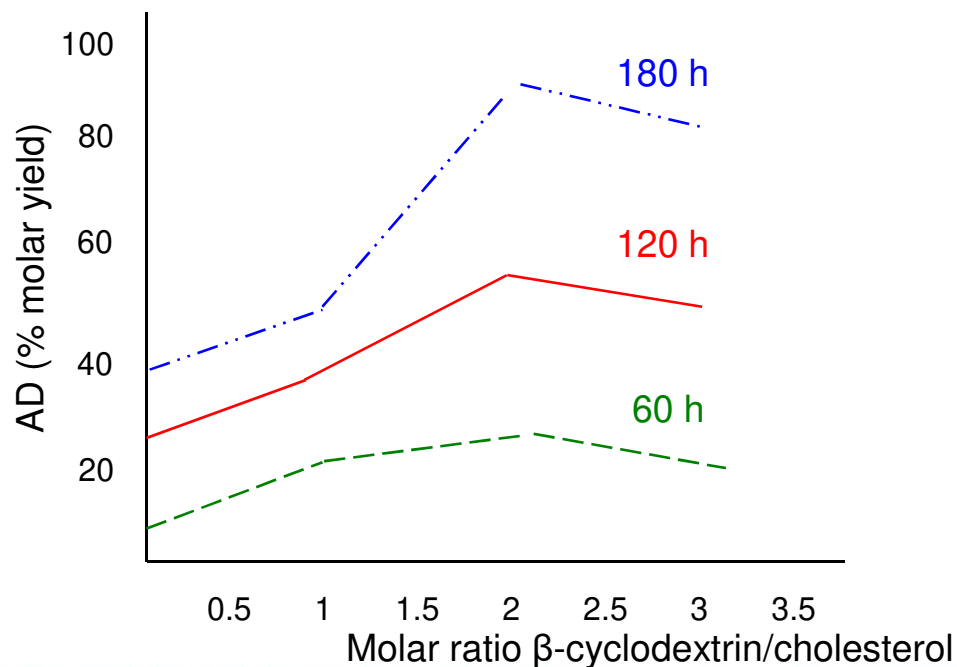
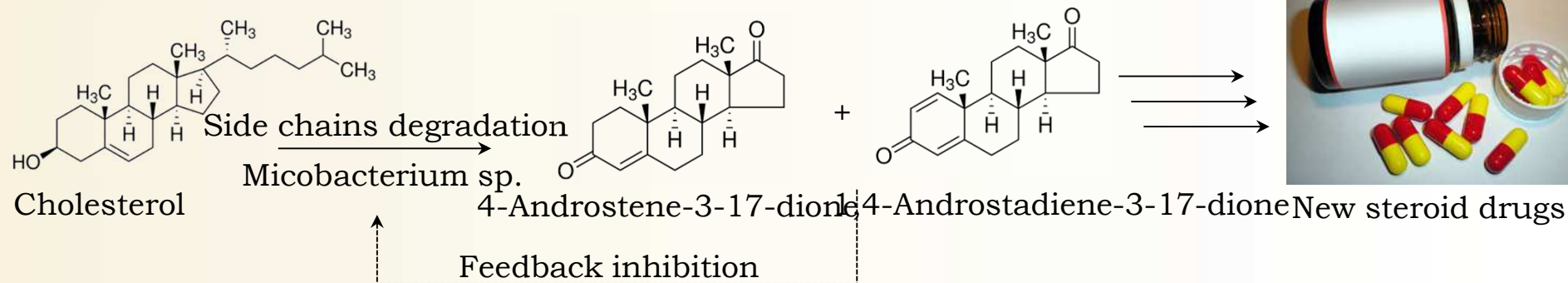
Who we are and what we offer?

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

Our services include:

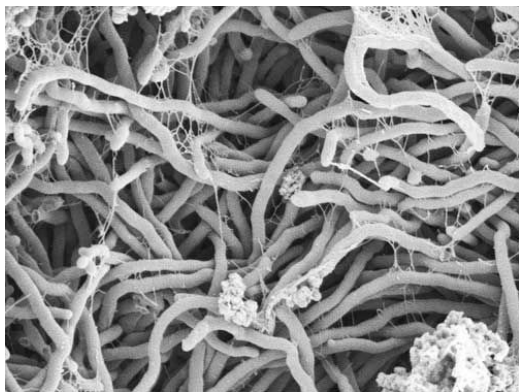
- **Supplying cyclodextrins for commercial products and product development;**
- **Screening cyclodextrin derivatives to find the right candidate for the request of customers;**
- **Providing formulation development services, composition optimization, stability assessment;**
- **Offering analytical services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

For more information please click [here](#)

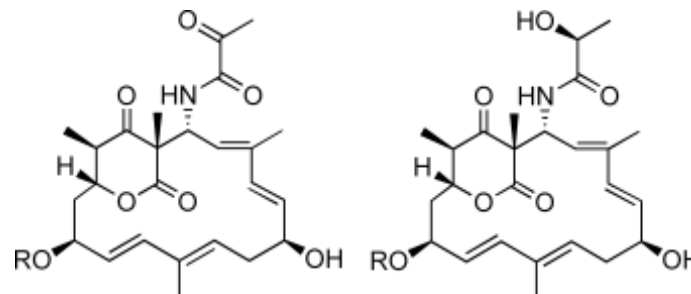


- **Enhanced conversion rate**
- **Decreased product inhibition**
- **Improved product stability**

Biosynthesis by fermentation



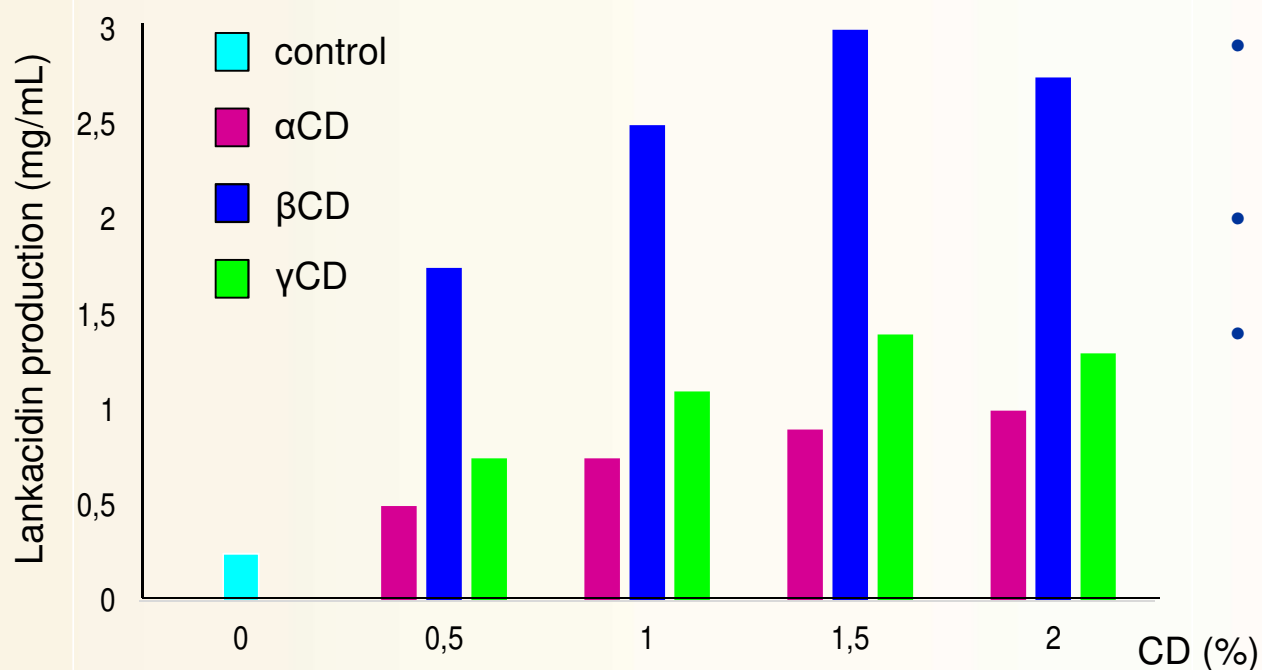
Streptomyces rochei volubilis



Lankacidin A (R=Ac)
Lankacidin C (R=H)

Lankacidinol A (R=Ac)
Lankacidinol C (R=H)

Macrolides Antitumor-Antibiotic



- **Enhanced production of antibiotics**
- **Diminished by-products formation**
- **Decreased product inhibition**

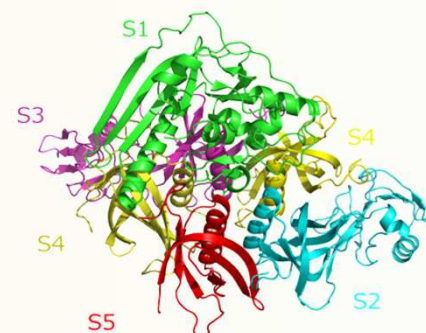
Sawada et al.: Appl. Microbiol. Biotechnol. 1990, 32, 556559



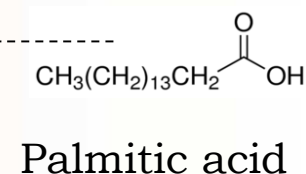
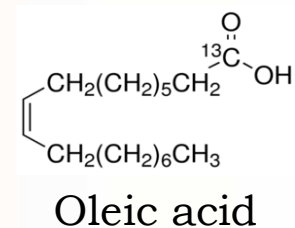
Bordetella pertussis

Production →

← inhibition



Pertussis toxin



Bordetella pertussis cell growth

Inoculum size cells in 5 µL	0	α	β	γ	DIMEB
10 ³	-	-	-	-	++
10 ⁴	-	-	-	-	+++
10 ⁵	-	-	-	-	+++
10 ⁶	-	++	+	+	+++
10 ⁷	-	+++	++	++	+++

- no growth + < 100 colonies ++ 10² to 10³ colonies +++ full growth

Complexation of fatty acids (growth inhibitors) results in enhanced cell growth and toxin production

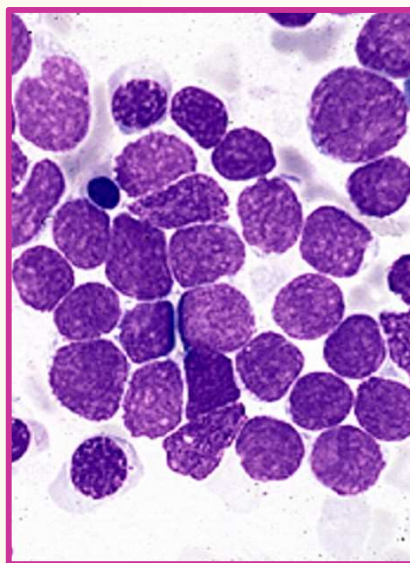
DIMEB (dimethyl beta-cyclodextrin) increases pertussin toxin production 100-fold!

Imaizumi *et al.*: Infect. Immun. 1983, 41, 1138-1143



Mycobacterium leprae

Water-soluble lipid/CD complexes:
Cultivation of non-cultivable *Mycobacterium leprae*;
Serum substitutes for lymphoblast cells;
Non-cholesterol interacting fatty acid/CD complexes

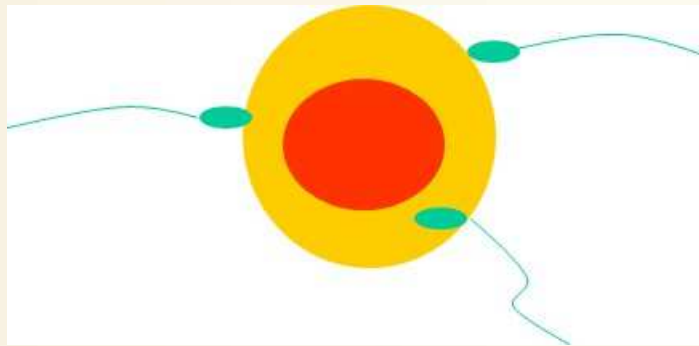


Lymphoblast cells

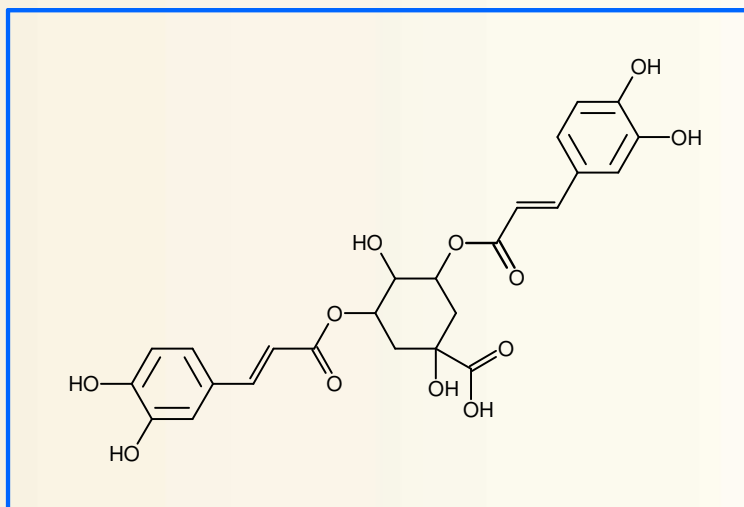
- **Solubilization of lipids (fatty acids, cholesterol, phospholipids)**
- **No threat of prion proteins**

Szente *et al.*: J. Incl. Phenom. Mol. Recogn. Chem. 1993, 16, 339-354
Rajnavölgyi *et al.* Beilstein J. Org. Chem. 2014, 10, 3152-3160

- Improvement of the quality of semen by cholesterol supplementation with cholesterol loaded methyl BCD (cryopreservation)
- Enhancement of capacitation and fertility rate by preincubation of thawed sperms with methyl BCD



Reducing enzymatic browning of fruit juices



chlorogenic acid (and other polyphenols)

Polyphenol oxidase
→



Browning

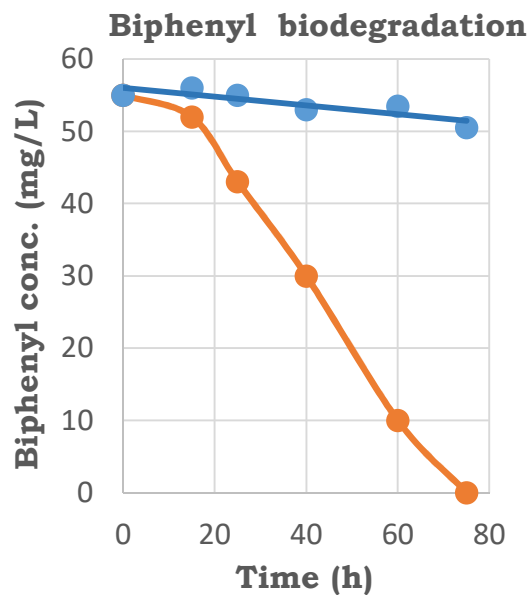
- **Complete inhibition of browning by soluble CDs**

$\alpha\text{CD} > \text{maltosyl } \beta\text{CD} > \beta\text{CD}$

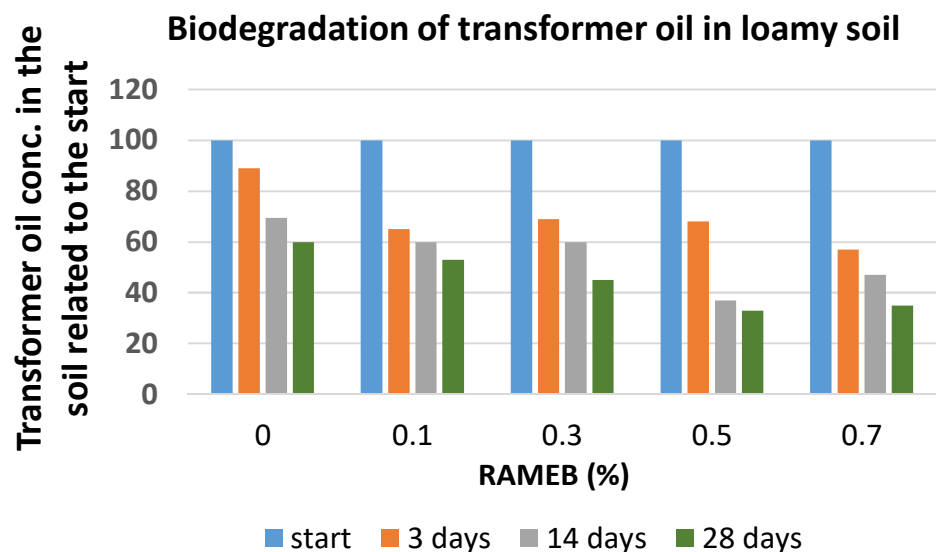
Hicks *et al.*: J. Agric. Food Chem. 1996, 44, 2098-2101

Lopez-Nicholas *et al.*: J. Agric. Food Chem. 2007, 55, 5312-5319

CD-assisted purification of waste water and soil



- Improved solubility/ bioavailability of the pollutants
- Improved cell growth
- Protection of the biological sludge in the waste water plants
- Enhanced microbial decomposition of contaminants



Yoshii *et al.*
Biol. J. Armenia,
2001, 18, 226-236
Fenyvesi *et al.*
Land Contam. Reclam.
2009, 17, 585-597



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