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Statistics on Cyclodextrin-related Patents

(Review based on the paper of Deorsola et al. in World Patent Information)

Deorsola et al. have performed a thorough patent search on CD-related patents in various databases and evaluated their search results in a recent paper [1]. They used free databases (Espacenet, USPTO, PATENT SCOPE and INPI, a Brazilian database) and DERWENT Innovation Index (freely accessible for universities). The period they evaluated was 1981-2011. For this 30-year period the search for cyclodextrin as keyword resulted in the highest number of hits (14,572) in DERWENT II, therefore the refined search was made in this database.

The number of patents increased in three steps: the first period lasted till 1990 followed by a slight drop; then a much faster rise was observed in 2000-2005, stopped for 2 years, followed by the almost doubled number of patents in 2008-2011 (Figure 1).

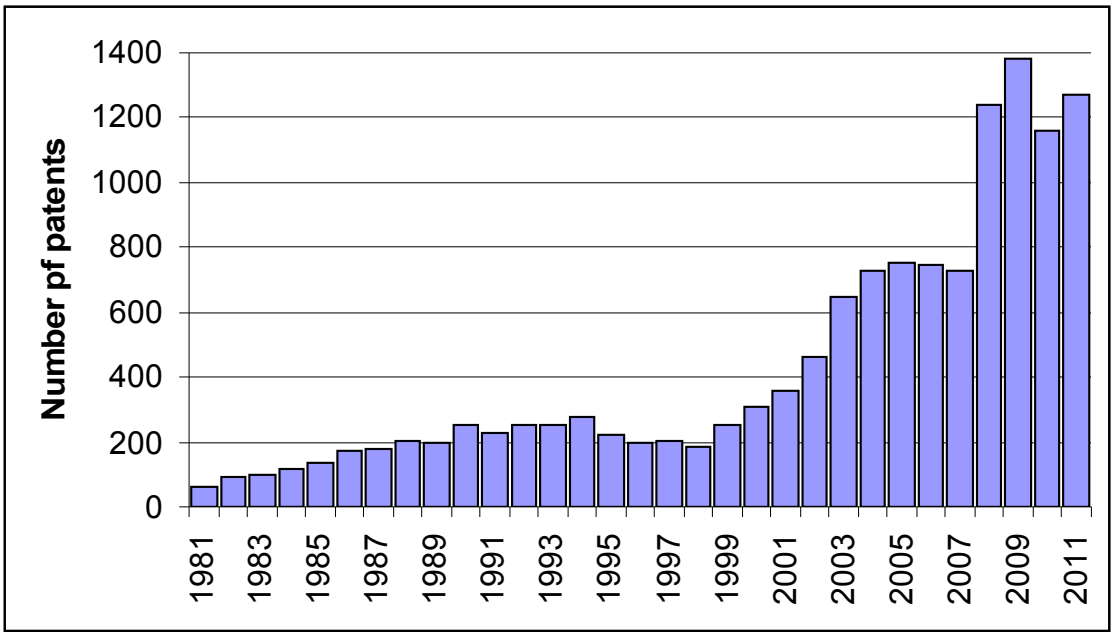

Figure 1.: Number of cyclodextrin-related patents in the world based on Derwent II database (accessed on January 7, 2013) (with the courtesy of Prof. Deorsola)

The patent applications filed in different patent offices were also evaluated. The statistics of the top 8 can be seen in Figure 2 showing the leading role of Asia, being Japan and China on the first and second positions, respectively. They are followed by the US and then by the European Patent office.

The leading companies concerning the number of their CD-related patent applications are Procter & Gamble Co. (>300), Kao Corp. (99), Schering AG (92), Ensuiko Sugar Refining Co. (83), and Ono Pharm. Co. (79).

Interestingly the top 10 inventors among the total of 20,198 inventors have all Chinese names (Wang, J., Li, Y., Li, X., Wang, Y., Zhang, Y, Wang X., Zhang, H., Li, J., Liu, Y., Zheng, Y.).

The classification of the patents allows an evaluation according to the topic of the inventions. This analysis shows that the most often selected classification is a kind of medicinal preparation characterized by the presence of non-active ingredients (excipients).

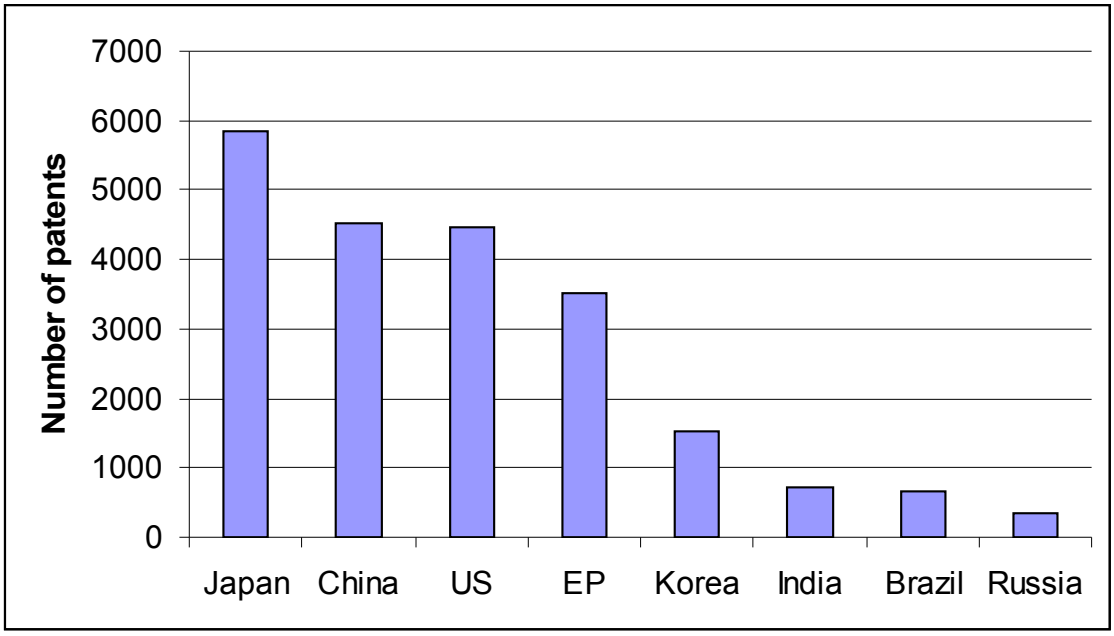

Figure 2.: Number of patent applications filed in patent offices of different countries based on Derwent II database (accessed on January 7, 2013) (with the courtesy of Prof. Deorsola)

References

1. A. C. Deorsola, C. G. Mothé, L. G. de Oliviera, A. B. Deorsola (2014) Technological monitoring of cyclodextrin – World panorama. World Patent Information, published online, DOI: 10.1016/j.wpi.2014.06.004

Éva Fenyvesi

CycloLab Cyclodextrin R&D Laboratory, Ltd.,
Budapest, HUNGARY

BIBLIOGRAPHY & KEYWORDS

1. CDs: Derivatives, Production, Enzymes, Toxicity

Ahn, H-J..; Li, C.; Cho, H-B.; Park, S.; Chang, P-S.; Kim, Y-W.

Enzymatic synthesis of 3-*O*-α-maltosyl-L-ascorbate using an engineered cyclodextrin glucanotransferase

L-Ascorbic acid, Cyclodextrin glucanotransferase, Acid/base mutant, 3-O-α-maltosyl-L-ascorbate, Transglycosylation, Mutant CGTase, Regioselective glycosylation

Food Chemistry, 2015, 169, 366-371; DOI:10.1016/j.foodchem.2014.07.110

2. CD complexes: Preparation, Properties in solution and in solid phase, Specific guest

Mitra, A. K.; Ghosh, S.; Sarangi, M. K.; Sau, A.; Saha, C.; Basu, S.

Influence of microheterogeneity on the solution phase photophysics of a newly synthesised, environment sensitive fluorophore 2-((7,8-dimethyl-1-oxo-2,3,4,9-tetrahydro-1H-carbazol-6-yl)oxy)acetic acid and its tagged derivative

Stokes shift, 1-Keto-1,2,3,4-tetrahydrocarbazole, Sodium dodecyl sulfate, Cetyl trimethyl ammonium bromide, Triton X-100, β-cyclodextrin

Journal of Photochemistry and Photobiology A: Chemistry, 2015, 296, 66-79; DOI:10.1016/j.jphotochem.2014.09.009

Periasamy, R.; Kothainayaki, S.; Sivakumar, K.

Investigation on intermolecular complexation between 4,4'-methylene-bis(N,N-dimethylaniline) and β-cyclodextrin: Preparation and characterisation in aqueous medium and solid state

4,4'-Methylene-bis(N,N-dimethylaniline), β-Cyclodextrin, Inclusion complex, Atomic Force Microscope, Differential Scanning Calorimetry, Molecular docking study

Journal of Molecular Structure, 2015, 1080, 69-79; DOI:10.1016/j.molstruc.2014.09.046

Periasamy, R.; Kothainayaki, S.; Rajamohan, R.; Sivakumar, K.

Spectral investigation and characterization of host-guest inclusion complex of 4,4'-methylene-bis(2-chloroaniline) with beta-cyclodextrin

4,4'-Methylene-bis(2-chloroaniline), β-Cyclodextrin, Inclusion complex, Atomic Force Microscope, UV-fluorescence spectrum, Molecular docking

Carbohydrate Polymers, 2014, 114, 558-566; DOI:10.1016/j.carbpol.2014.08.006

Prabhu, A. A. M.; Kumar, G. S. S.; Fatiha, M.; Sorimuthu, S.; Raj, M. S.

Encapsulation of phenylalanine and 3,4-dihydroxyphenylalanine into β-cyclodextrin: Spectral and molecular modeling studies

Phenylalanine, 3,4-Dihydroxyphenylalanine, β-Cyclodextrin, PM3 calculations, NBO

Journal of Molecular Structure, 20154, 1079, 370-382; DOI:10.1016/j.molstruc.2014.08.045

Quaranta, A.; Qu, H.; Vencel, T.; Zhang, Y.; Leibl, W.; Leach, S.; Bensasson, R. V.

Photophysical properties in aqueous solutions of C_{60} embedded in 2:1 γ-cyclodextrin/ [60]fullerene inclusion complexes

C_{60} Triplet State, Photodestruction, Quantum Yields, γ-CD/C_{60} Inclusion Complexes, 2:1 γ–CD Inclusion Complexes

Chemical Physics Letters, 2014, 614, 234-237; DOI:10.1016/j.cplett.2014.09.046

Rahim, M.; Madi, F.; Nouar, L.; Bouhadiba, A.; Haiahem, S.; Khatmi, D. E.; Belhocine, Y.

Driving forces and electronic structure in β-cyclodextrin/3,3'-diaminodiphenylsulphone complex

β-CD, 3,3'-Diaminodiphenylsulphone, PM6, ONIOM2, NBO

Journal of Molecular Liquids, 2014, 199, 501-510; DOI:10.1016/j.molliq.2014.09.035

Rajendiran, N.; Venkatesh, G.

Micrometer size rod formed by secondary self assembly of omeprazole with α- and β-cyclodextrins

Omeprazole, Cyclodextrin, Nanorod, Inclusion complex, Supramolecular architecture, Molecular modeling, Inter-nanotubular hydrogen bonding

Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 2015, 137, 832-840; DOI:10.1016/j.saa.2014.08.074

Rogez-Florent, T.; Azaroual, N.; Goossens, L.; Goossens, J-F.; Danel, C.

NMR investigation of the complexation and chiral discrimination of pyrazole sulfonamide derivatives with cyclodextrins

Cyclodextrin, Sulfonamide derivatives, Inclusion complex, NMR spectroscopy, Chiral discrimination, HP-β-CD, Me-β-CD, NH_2-β-CD

Carbohydrate Polymers, 2015, 115, 598-604; DOI:10.1016/j.carbpol.2014.09.046

Sengupta, C.; Sarangi, M. K.; Sau, A.; Mandal, D.; Basu, S.

A case study of photo induced electron transfer between riboflavin and aliphatic amine: Deciphering different mechanisms of ET operating from femtosecond to microsecond time domain

Riboflavin, Organized assemblies, Radical ions/pairs, Transient absorption, H-abstraction, β-Cyclodextrin

Journal of Photochemistry and Photobiology A: Chemistry, 2015, 296, 25-34; DOI:10.1016/j.jphotochem.2014.09.010

Shao, K.; Wang, H.; Peng, A.

Inclusion of CdS quantum DoT into beta-cyclodextrin crystal by simple rapid crystallization

Low dimensional structures, Nucleation, Growth from solution, Oxides

Journal of Crystal Growth, 2015, 409, 10-13; DOI:10.1016/j.jcrysgro.2014.09.022

Soleymanpour, A.; Ghasemian, M.

Chemically modified carbon paste sensor for the potentiometric determination of carvedilol in pharmaceutical and biological media

Carvedilol, Carbon paste electrode, Potentiometry, Pharmaceutical analysis, β-Blocker

Measurement, 2015, 59, 14-20; DOI:10.1016/j.measurement.2014.09.046

Terekhova, I.; Chibunova, E.; Kumeev, R.; Kruchinin, S.; Fedotova, M.; Kozbiał, M.; Wszelaka-Rylik, M.; Gierycz, P.

Specific and nonspecific effects of biologically active inorganic salts on inclusion complex formation of cyclodextrins with aromatic carboxylic acids

Cyclodextrin, m-Aminobenzoic Acid, Nicotinic acid, Complex formation, Salt effect, Thermodynamics, KCl, KBr, KH_2PO_4, K_2SO_4

Chemical Engineering Science, 2015, 122, 97-103; DOI:10.1016/j.ces.2014.09.025

Zhao, Y.; Yong, G.; Zhang, X.; Zhang, B.

Reversibly photoswitchable dual-color (blue ↔ green) phosphorescence from β-cyclodextrin inclusion complex materials

3-Formyl-2,3'-biimidazo[1,2-a]pyridin-2'-ones, Cyclodextrin inclusion complexes, Molecular assembles, Supramolecular materials, Phosphorescence enhancement, Photoswitchable phosphorescent Colors, Excitation with Ultraviolet Light, Irradiation by Visible Light

Dyes and Pigments, 2014, 101, 172-178; DOI:10.1016/j.dyepig.2013.10.008

3. CDs in Drug Formulation

Bulani, V.; Kothavade, P.; Nagmoti, D.; Juvekar, A.

19: Ellagic acid hydroxypropyl-β-cyclodextrin inclusion complex alleviates adjuvant-induced arthritis: Attenuation of oxidative stress and inflammatory mediators

Nitric oxide, Glutathione, Superoxide dismutase, IL-6, TNF-α

Cytokine, 2014, 70, 32; DOI:10.1016/j.cyto.2014.07.026; SI: 2014 ICIS Abstract Issue ICIS Conference

Uebelhack, R.; Busch, R.; Alt, F.; Beah, Z-M.; Chong, P-W.

Effects of cactus fiber on the excretion of dietary fat in healthy subjects: A double blind, randomized, placebo-controlled, crossover clinical investigation

Cactus Fiber, Litramine IQP-G-002AS, Acacia spp, Co-processed with cyclodextrin

Current Therapeutic Research, 2014, 76, 39-44; DOI:10.1016/j.curtheres.2014.02.001; Erratum: Current Therapeutic Research, 2014, 76, 63; DOI:10.1016/j.curtheres.2014.07.004

Dandawate, P.; Vemuri, K.; Swamy, K. V.; Khan, E. K.; Sritharan, M.; Padhye, S.

Synthesis, characterization, molecular docking and anti-tubercular activity of Plumbagin–Isoniazid Analog and its β-cyclodextrin conjugate

Plumbagin, Plumbagin-Isoniazid Analog, β-Cyclodextrin, Inclusion complex, Antitubercular activity, Molecular docking, Superior activity, Overcoming resistance

Bioorganic & Medicinal Chemistry Letters, 2014, 24, 5070-5075; DOI:10.1016/j.bmcl.2014.09.032

Dsugi, N. F. A.; Elbashir, A. A.

Supramolecular interaction of Moxifloxacin and β-cyclodextrin spectroscopic characterization and analytical application

Moxifloxacin, Inclusion Complex, β-CD, FTIR, NMR, Fluorescence spectroscopy

Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 2015, 137, 804-809; DOI:10.1016/j.saa.2014.08.081

Gaurav, C.; Goutam, R.; Rohan, K. N.; Sweta, K. T.; Abhay, C. S.; Amit, G. K.

(Copper-curcumin) β-cyclodextrin vaginal gel: Delivering a novel metal-herbal approach for the development of topical contraception prophylaxis

Copper-curcumin, β-Cyclodextrin, Nano-inclusion complex, Spermicidal gel, Spermicidal assay, Toxicity studies in rats and rabbits

European Journal of Pharmaceutical Sciences, 2014, 65, 183-191; DOI:10.1016/j.ejps.2014.09.019

Iannazzo, D.; Mazzaglia, A.; Scala, A.; Pistone, A.; Galvagno, S.; Lanza, M.; Riccucci, C.; Ingo, G. M.; Colao, I.; Sciortino, M. T.; Valle, F.; Piperno, A.; Grassi, G.

β-Cyclodextrin-grafted on multiwalled carbon nanotubes as versatile nanoplatform for entrapment of guanine-based drugs

Click chemistry, Multiwalled Carbon nanotubes, β-Cyclodextrins, Guanine, Acyclovir, Sustained delivery

Colloids and Surfaces B: Biointerfaces, 2014, *In Press*; DOI:10.1016/j.colsurfb.2014.09.025

Kim, J. Y.; Wood, R. I.

Anabolic-androgenic steroids and appetitive sexual behavior in male rats

Anabolic agents, Androgen, Food reward, Operant behavior, Sexual behavior, animal

Hormones and Behavior, 2014, 66, 585-590; DOI:10.1016/j.yhbeh.2014.08.009

Kono, H.; Teshirogi, T.

Cyclodextrin-grafted chitosan hydrogels for controlled drug delivery

Carboxymethyl chitosan, Carboxymethyl cyclodextrin, Hydrogel, Acetylsalicylic acid, Controlled drug release

International Journal of Biological Macromolecules, 2015, 72, 299-308; DOI:10.1016/j.ijbiomac.2014.08.030

Kumar, N.; Goindi, S.; Bansal, G.

Physicochemical evaluation and *in vitro* release studies on itraconazolium sulfate salt

Itraconazole, Solubility, Dissolution, Cyclodextrins, BCS Class II, Antifungal, β-CD, HP-β-CD

Asian Journal of Pharmaceutical Sciences, 2014, 9, 8-16; DOI:10.1016/j.ajps.2013.12.003

Li, X.; Yu, Y.; Ji, Q.; Qiu, L.

Targeted delivery of anticancer drugs by aptamer AS1411 mediated Pluronic F127/cyclodextrin-linked polymer composite micelles

Aptamer, Composite micelles, Cyclodextrin, Pluronic F127, Doxorubicin, Targeted delivery of doxorubicin

Nanomedicine: Nanotechnology, Biology and Medicine, 2014, *In Press*; DOI:10.1016/j.nano.2014.08.013

Luo, X.; Zhang, H.; Chen, M.; Wei, J.; Zhang, Y.; Li, X.

Antimetastasis and antitumor efficacy promoted by sequential release of vascular disrupting and chemotherapeutic agents from electrospun fibers

Electrospun fiber, Vascular disrupting agent, Release modulation, Antitumor efficacy, Tumor metastasis, Combretastatin, Inoculation of (2-hydroxy)propil-β-cyclodextrin in fiber matrices, Orthotopic breast tumor model, Sustained release

International Journal of Pharmaceutics, 2014, 475, 438-449; DOI:10.1016/j.ijpharm.2014.09.006

Matloob, A. H.; Mourtas, S.; Klepetsanis, P.; Antimisiaris, S.

Increasing the stability of curcumin in serum with liposomes or hybrid drug-in-cyclodextrin-in-liposome systems: A comparative study

Curcumin, Liposome, Cyclodextrin, Inclusion complex, Stability, Serum, HP-β–CD, HP-γ–CD

International Journal of Pharmaceutics, 2014, 476, 108-115; DOI:10.1016/j.ijpharm.2014.09.041

Matsuo, M.; Shraishi, K.; Wada, K.; Ishitsuka, Y.; Doi, H.; Maeda, M.; Mizoguchi, T.; Eto, J.; Mochinaga, S.; Arima, H.; Irie, T.;

Effects of intracerebroventricular administration of 2-hydroxypropyl-β-cyclodextrin in a patient with Niemann-Pick Type C disease

Niemann-Pick Type C disease, Cyclodextrin, Cholesterol, Intrathecal administration, Intracerebroventricular administration, Pharmacokinetics, Blood-brain barrier, Intrathecal HP-β-CD

Molecular Genetics and Metabolism Reports, 2014, 1, 391-400; DOI:10.1016/j.ymgmr.2014.08.004

Mura, P.; Bragagni, M.; Mennini, N.; Cirri, M.; Maestrelli, F.

Development of liposomal and microemulsion formulations for transdermal delivery of clonazepam: Effect of randomly methylated β-cyclodextrin

Clonazepam, Randomly methylated β-cyclodextrin, Microemulsions, Liposomes, Transdermal delivery, Permeation enhancers, Permeation through excised rabbit ear skin, Increased drug permeability

International Journal of Pharmaceutics, 2014, 475, 306-314; DOI:10.1016/j.ijpharm.2014.08.066

Sudha, N.; Chandrasekaran, S.; Sameena, Y.; Israel, V.M.V.E.

Mode of encapsulation of Linezolid by β-cyclodextrin and its role in bovine serum albumin binding

Linezolid, β-Cyclodextrin, 2D ROESY, Bovine serum albumin, Fluorescence, FRET, Flourescence quenching, Förster resonance energy transfer

Carbohydrate Polymers, 2015, 115, 589-597; DOI:10.1016/j.carbpol.2014.09.022

Nguyen, D.N.; Van den Mooter, G.

The fate of ritonavir in the presence of darunavir

Ritonavir, Darunavir, Solid dispersion, Spray drying, Cyclodextrins, Solubility, (2-hydroxy)propyl-β-cyclodextrin

International Journal of Pharmaceutics, 2014, 475, 214-226; DOI:10.1016/j.ijpharm.2014.08.062

Rieant, E.; Debaene, B.; Kerforne, T.; Giraud, B.; Chauvet, S.; Hebrard, W.; Hauet, T.; Mimoz, O.

Étude *in vitro* de l'impact du Sugammadex (Sdx) sur les paramètres de Thrombélastométrie (TEM) chez un modèle porcin

Annales Françaises d'Anesthésie et de Réanimation, 2014, 33, Supplement 2, A256-A257; DOI:10.1016/j.annfar.2014.07.434

Yaméogo, J. B. G.; Gèze, A.; Choisnard, L.; Putaux, J-L.; Mazet, R.; Passirani, C.; Keramidas, M.; Coll, J-L.; Lautram, N.; Bejaud, J.; Semdé, R.; Wouessidjewe, D.;

Self-assembled biotransesterified cyclodextrins as potential Artemisinin nanocarriers. II: *in vitro* behavior toward the immune system and *in vivo* biodistribution assessment of unloaded nanoparticles

Bioesterified γ-cyclodextrins, Artemisinin, PEGylated amphiphiles, Co-nanoprecipitation, Surface-decorated nanoparticles, Hemolytic properties, Stealth properties, Biodistribution, γ-CD fatty esters

European Journal of Pharmaceutics and Biopharmaceutics, 2014, *In Press*; DOI:10.1016/j.ejpb.2014.08.012

Yum, M-S.; Lee, M.; Ko, T-S.; Velíšek, L.

A potential effect of ganaxolone in an animal model of infantile spasms

Ganaxolone, Infantile spasms, Animal model, GABA, Neurosteroid

Epilepsy Research, 2014, 108, 1492-1500; DOI:10.1016/j.eplepsyres.2014.08.015

4. CDs in Cell Biology

Crichton, E. G.; Pukazhenthi, B.; Billah, M.; Skidmore, J. A.

Cholesterol addition aids the cryopreservation of dromedary camel (*Camelus dromedarius*) spermatozoa

Camel, Sperm, CLC, Acrosomal integrity, Capacitation, Cholesterol-loaded cyclodextrin, Enhanced cryosurvival

Theriogenology, 2014, *In Press*; DOI:10.1016/j.theriogenology.2014.09.005

Pfeiffer, E. R.; Wright, A. T.; Edwards, A. G.; Stowe, J. C.; McNall, K.; Tan, J.; Niesman, I.; Patel, H. H.; Roth, D. M.; Omens, J. H.; McCulloch, A. D.

Caveolae in ventricular myocytes are required for stretch-dependent conduction slowing

Cardiac mechanoelectric feedback, Caveolae, Capacitance, Membrane cholesterol depletion by methyl-β-cyclodextrin

Journal of Molecular and Cellular Cardiology, 2014, 76, 265-274; DOI:10.1016/j.yjmcc.2014.09.014

5. CDs in Food, Cosmetics and Agrochemicals

Higueras, L:; López-Carballo, G.; Gavara, R.; Hernández-Muñoz, P.

Incorporation of hydroxypropyl-β-cyclodextrins into chitosan films to tailor loading capacity for active aroma compound carvacrol

Chitosan, (2-Hydroxy)propyl-β-cyclodextrins, Carvacrol, Loading and release, Antimicrobial films, Glycerol, Plasticization of the film

Food Hydrocolloids, 2015, 43, 603-611; DOI:10.1016/j.foodhyd.2014.07.017

Marsh, Z.; Yang, T.; Nopo-Olazabal, L.; Wu, S.; Ingle, T.; Joshee, N.; Medina-Bolivar, F.

Effect of light, methyl jasmonate and cyclodextrin on production of phenolic compounds in hairy root cultures of *Scutellaria lateriflora*

Scutellaria, Lamiaceae, Hairy roots, Verbascoside, Wogonin, Baicalein, Scutellarein, Phenolics, Methyl jasmonate, Cyclodextrin, Elicitation, Methyl-β-cyclodextrin

Phytochemistry, 2014, 107, 50-60; DOI:10.1016/j.phytochem.2014.08.020

Poór, M.; Kunsági-Máté, S.; Szente, L.; Matisz, G.; Secenji, Gy.; Czibulya, Zs.; Kőszegi, T.

Interaction of ochratoxin A with quaternary ammonium beta-cyclodextrin

Ochratoxin A, Cyclodextrin, Molecular inclusion, Fluorescence spectroscopy, Detoxification, Decontamination of drinks

Food Chemistry, 2015, 172, 143-149; DOI:10.1016/j.foodchem.2014.09.034

Santos, E. H.; Kamimura, J. A.; Hill, L. E.; Gomes, C. L.

Characterization of carvacrol beta-cyclodextrin inclusion complexes as delivery systems for antibacterial and antioxidant applications

Carvacrol, Natural antimicrobial, β-cyclodextrin inclusion complexes, Storage stability, Antimicrobial activity, Kneading, Freeze drying

LWT- Food Science and Technology, 2015, 60, 583-592; DOI:10.1016/j.lwt.2014.08.046

6. CDs for other Industrial Applications

Liu, H.; Li, Y.; Wu, H.; Yang, W.; He, D.;

Effects of Nd, Ce, and La modification on catalytic performance of Ni/SBA-15 catalyst in CO_2 reforming of CH_4

Rare earth metal, Nd modification, Nickel, SBA-15 catalyst, Carbon dioxide reforming of methane, Carbon deposition, β-Cyclodextrin-modified impregnation method

Chinese Journal of Catalysis, 2014, 35, 1520-1528; DOI:10.1016/S1872-2067(14)60095-4

Moulahcene, L.; Skiba, M.; Senhadji, O.; Milon, N.; Benamor, M.; Lahiani-Skiba, M.

Inclusion and removal of pharmaceutical residues from aqueous solution using water-insoluble cyclodextrin polymers

Progesterone, Endocrine disruptor, Cyclodextrin polymer (PolyCyC®), Adsorption, Crosslinked with citric acid, Recycling column procedure

Chemical Engineering Research and Design, 2014, *In Press*; DOI:10.1016/j.cherd.2014.08.023

Spasojević, J. M.; Maletić, S. P.; Rončević, S. D.; Radnović, D. V.; Čučak, D. I.; Tričković, J. S.; Dalmacija, B. D.

Using chemical desorption of PAHs from sediment to model biodegradation during bioavailability assessment

PAH, XAD4, MCD, Biodegradation, Desorption, Methyl-β-cyclodextrin

Journal of Hazardous Materials, 2015, 283, 60-69; DOI:10.1016/j.jhazmat.2014.09.013

Wang, B.; Qian, X.; Shi, Y.; Yu, B.; Hong, N.; Song, L.; Hu, Y.

Cyclodextrin microencapsulated ammonium polyphosphate: Preparation and its performance on the thermal, flame retardancy and mechanical properties of ethylene vinyl acetate copolymer

A. Polymer-matrix composites(PMCs), B. Physical properties, C. Thermal analysis, D. Mechanical testing, Microencapsulation, Toluene-2,4-diisocyanate, Ethylene vinyl acetate copolymer, Water durability

Composites Part B: Engineering, 2015, 69, 22-30; DOI:10.1016/j.compositesb.2014.09.015

Zhang, X.; Wang, Y.; Yang, S.

Simultaneous removal of Co(II) and 1-naphthol by core-shell structured Fe_3O_4@cyclodextrin magnetic nanoparticles

Fe_3O_4@CD MNPs, Co(II), 1-Naphthol, Simulated effluent, Magnetic separation, Co-precipitation

Carbohydrate Polymers, 2014, 114, 521-529; DOI:10.1016/j.carbpol.2014.08.072

Zhang, F-B.; Jiang, J-X.; Ni, Y.

Synthesis of Pd/C composites from $PdCl_2$ and β-CD as a catalyst in methanol oxidation

Pd nanoparticles, β-CD, TEM, Electrode

Materials Science and Engineering: B, 2014, 190, 90-95; DOI:10.1016/j.mseb.2014.09.012

7. CDs in Sensing and Analysis

Bathinapatla, A.; Kanchi, S.; Singh, P.; Sabela, M. I.; Bisetty, K.

Fabrication of copper nanoparticles decorated multiwalled carbon nanotubes as a high performance electrochemical sensor for the detection of neotame

Neotame, Electrochemical sensor, Cyclic voltammetry, Differential pulse voltammetry, β-Cyclodextrin/glassy carbon electrode

Biosensors and Bioelectronics, 2014, *In Press*; DOI:10.1016/j.bios.2014.08.017

Ghanem, A.; Ahmed, M.; Ishii, H.; Ikegami, T.

Immobilized β-cyclodextrin-based silica *vs* polymer monoliths for chiral nano liquid chromatographic separation of racemates

β-Cyclodextrin methacrylate, Silica monolith, Polymer monolith, Chiral separation, Nano-LC, Reversed phase chromatography, Baseline separation for alprenolol, bufuralol, carbuterol, cizolertine, propranolol, tebuconazole

Talanta, 2015, 132, 301-314; DOI:10.1016/j.talanta.2014.09.006

Hamilton, A.; Breslin, C. B.

The development of a novel urea sensor using polypyrrole

Polypyrrole, Urea sensor, Urease, Cyclodextrin, Ascorbic acid, Polypyrrole-urease-sulfonated-β-cyclodextrin

Electrochimica Acta, 2014, 145, 19-26; DOI:10.1016/j.electacta.2014.08.052

Lenik, J.

A new potentiometric electrode incorporating functionalized β-cyclodextrins for diclofenac determination

Potentiometric electrode, Diclofenac, Pharmaceutical analysis, Diclofenac-selective membrane electrodes, (2-Hydroxy)propyl-β-cyclodextrin, Heptakis(2,3,6-tri-O-methyl)-β-cyclodextrin, Heptakis(2,3,6-tri-O-benzoyl)-β-cyclodextrin

Materials Science and Engineering: C, 2014, 45, 109-116; DOI:10.1016/j.msec.2014.08.072

Mohan, H. K. S. V.; An, J.; Liao, K.; Wong, C. H.; Zheng, L.

Detection and classification of host-guest interactions using β-cyclodextrin-decorated carbon nanotube-based chemiresistors

Carbon nanotubes, Chemiresistor, Cyclodextrin, Sensing, Correlation, 9-Anthracenecarboxylic acid, Diclofenac sodium, Curcumin, Perylene tetracarboxylic acid

Current Applied Physics, 2014, 14, 1649-1658; DOI:10.1016/j.cap.2014.09.017

Wahl, O.; Holzgrabe, u.;

Evaluation of enantiomeric purity of magnesium-L-aspartate dihydrate

Pharmaceutical analysis, Capillary electrophoresis, Magnesium aspartate, Chiral separation, Racemization, (2-Hydroxy)propyl-β-cyclodextrin coupled to laser induced fluorescence detection

Journal of Pharmaceutical and Biomedical Analysis, 2015, 102, 100-109; DOI:10.1016/j.jpba.2014.08.013

Yang, L.; Zhao, H.; Li, C-P.; Fan, S.; Li, B.

Dual β-cyclodextrin functionalized Au@SiC nanohybrids for the electrochemical determination of tadalafil in the presence of acetonitrile

Host-guest, β-Cyclodextrin functionalized Au@SiC, Molecular recognition, Tadalafil, Electrochemical sensing, SH-β-CD, Differential pulse voltametry

Biosensors and Bioelectronics, 2015, 64, 126-130; DOI:10.1016/j.bios.2014.08.068

Zhang, J.; Pan, M.; Gan, N.; Cao, Y.; Wu, D.

Employment of a novel magnetically multifunctional purifying material for determination of toxic highly chlorinated polychlorinated biphenyls at trace levels in soil samples

Clean-up, Carboxymethyl-β-cyclodextrin, Organochlorine pesticide, Highly chlorinated polychlorinated biphenyls, Gas chromatography-mass spectrometry

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Homepage:www.cyclolab.hu
H-1525 P.O. 435, Budapest, Hungary
Tel:(361) 347-6060
Fax: (361) 347-6068
e-mail: cyclolab@cyclolab.hu