Lindner Lecture
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Chiral Anionic, Cationic and Zwitterionic Ion Exchangers for Stereoisomer Separations, including Amino Acids and Peptides; Molecular Recognition Principles and Operational Modes.

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Low molecular mass chiral acids and bases can usually be liquid chromatographically enantiomer separated in their non-charged/non ionized form on diverse chiral stationary phases (CSPs) derived from: polysaccharides, cyclofructands, macrocyclic antibiotics, proteins, etc. Also Pirkle type CSPs can sometimes solve the tasks.

So what could be of interest to develop chiral ion exchangers like WAX/SAX, WCX/SCX and zwitterionic (ZWIX) materials:
(i) ion exchangers work without restrictions in polar and hydroorganic solvent mixtures but also in SubFC (SFC) mode which can be a big advantage not only for prep chromatography;
(ii) from a mechanistic point of view the retention is tuneable via pH adjustment and/or buffer concentration in the mobile phase;
(iii) loadability can be very high according to stoichiometric binding models being in place;
(iv) very polar zwitterionic ampholytes can be retained and resolved stereoselectively.

Electrostatic interactions (ion pairing) between the charged chiral selector (SO) moieties and the chiral selectands (SAs) are the driving forces to generate retention. In concert with the spatially arranged chiral motifs of the SO and SAs thus involving additional intermolecular hydrogen bonding, aryl-aryl, and hydrophobic interaction increments this will tune the overall molecular recognition concept. Of particular interest can also be the simultaneously occurring bis-modal ionic interaction of zwitterionic SAs with a zwitterionic SO.

Focus of this lecture will be: (i) the design of chiral ion exchanger type SOs and CSPs with particular emphasis also on zwitterionic SO motifs, (ii) molecular recognition aspects in context to the contribution of mobile phase modes and components, and (iii) stereoselective analysis of free and N-protected amino acids, peptides and peptomimetics.
Enantioseparation of other acids and bases will also be discussed.
Condensed Curriculum Vitae of Dr. Wolfgang F. LINDNER  
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Born: 3rd October 1943, in Mittenwald (Bavaria/Germany), Austrian citizen

Educational Background and Professional Career:

Oct.1962 - June 1972 University of Vienna and University of Graz (Austria), PhD in Organic Chemistry
1972 - 1996 Ass.Prof. and Assoc.Prof. at Institute of Pharmaceutical Chemistry, University of Graz
1978/79 Post-doc at Northeastern University (Prof.B.L.Karger), Boston, MA, USA
Jan. 1982 Habilitation for Pharmaceutical / Analytical Chemistry, University of Graz
1986/87 International Visiting Scientist at FDA (Dr.F.Robey), Bethesda, MD, USA
1996-2012 Chair for Analytical Chemistry at the University of Vienna (Austria)

Publications: >400; Book Chapters: 12; Patents: (subjectively different) 14 / 13 granted

Research Activities:

- Enantioselective Separation Techniques and Materials, related to HPLC, CE, CEC, GC, CPC, membranes, crystallisation, molecularly imprinted polymers (MIPs)
- Novel Stationary Phases for LC in context to Power of Selectivity in Chromatography (Chiral) cation, anion and zwitterionic ion exchange materials
- Molecular Recognition: design and synthesis of chiral compounds used as: chiral selectors (receptors, hosts), ligands as building blocks; chiral drugs; and chiral polymers
- Elucidation of Molecular Recognition Phenomena, QSAR, spectroscopy
- Stereoselective Pharmacokinetics involving HPLC, CE, GC, GC-MS, LC-MS/MS
- Molecular Recognition: selectivity in separation and sequencing in Proteomics research, including MS/MS technologies, using also chemoselective Tagging Strategies
- Affinity Chromatography: design, synthesis and application of dedicated peptomimetic ligands and related materials for protein separation (e.g. monoclonal antibodies, purification out of cell supernants)
- Affinity concepts to elucidate and identify drug-protein binding events during selective protein pull-down materials
- Highly selective affinity chromatography concept to separate and isolate plasmid DNA topoisomers.
- Mixed Modal Stationary Phases for HPLC and multidimensional HPLC
- HILIC phases and elucidation of retention and selectivity mechanism.
- Proteomics and Lipidomics Analysis and its applications using LC-MS/MS methodologies
- Derivatization strategies used in Proteomics and Metabolomics for selective trapping and tagging, including differential quantification applying MS analysis
- Mycotoxin Analysis in biological matrices and mycotoxin detoxification involving sonochemistry
- Food, Environmental and Pesticide Analysis: oil adulteration, antibiotics in meat, etc.
- Pharmaceutical Analysis of drug substances, pharmaceutical formulations etc.
2002-2009 Christian-Doppler-Laboratory for Molecular Recognition Materials (CDL for MRM), foundation together with M. Laemmerhofer

Dedicated material with (stereo)selective properties, chiral stationary phases, monoliths, including dedicated surface modification strategies; separation and tagging strategies to be used as tools in Proteomics and Metabolomics research; emphasis is given also towards novel affinity materials to be used in amino acid, peptide and protein analysis and purification; (duration 7 years)

Citations:
1991: Jubilee Medal of the British Chromatographic Society
1992: Austrian Award for Cardiology (together with K.Stoschitzky and W.Klein)
1995: Tswett Memorial Medal
1995: 1st Winner of the Belgian Pharmaceutical Society Award
2001: Japan Society for the Promotion of Science (JSPS)
2003: Honorary Membership of the Hungarian Society for Separation Sciences
2007: Halász Medal Award of the Hungarian Society for Separation Sciences
2008: Chirality Medal Award 2008
2009: A. J. P. Martin Gold Medal
2010: Molecular Chirality Award of Japan
2012: ACS Award in Chromatography


Member of Editorial Boards:

Steering Committees and Permanent Scientific Committee Member,
Professional Societies:
Symposium Series: HPLC (Int. Symposium on High Performance Liquid Chromatography)
ISCD/Chirality (International Symposium on Chiral Discrimination)
PBA (Int. Symposium on Pharmaceutical and Biomedical Analysis)

President of the Austrian Society of Analytical Chemistry (ASAC) 2001-2011.

National and European Research Programs:
- Management Committee of COST D11 Action on “Supramolecular Chemistry” and on COST D31 Action on "Organising Non-Covalent Chemical Systems with Selected Functions"
- Coordinator of multilateral European research and development Brite Euram III project on “Chiral Membranes” (1998-2000);
- Sub Project Coordinator of "Reduced Allergenicity of Processed Food" (REDALL) (2003-2006)
- Sub Project Coordinator of "Advanced Interactive Materials by Design" (AIMs) (2004-2007)
Symposium Chairman:

1994: Solid Phase Extraction and Technology ´94, Amsterdam;
1995: 19th International Symposium on Liquid Chromatography, HPLC’95, Innsbruck;
1998: 10th International Symposium on Chiral Discrimination, ISCD’98, Vienna;
2000: 11th International Symposium on Pharmaceutical and Biomedical Analysis, PBA’2000, Basel (co-chair with Eric Francotte);
2000: 3rd Workshop of COST Action on Supramolecular Chemistry, Vienna 2000;
2009: Euroanalysis 2009, Innsbruck (co-chair with Wolfgang Buchberger)

W. Lindner