

## Abstract of the talk:

### Are non-linear processes omnipresent or rare?

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Non-linear chemical processes are not included in the undergraduate chemistry curricula in most universities throughout Europe, and also outside Europe. Consequently, most chemistry graduates (at the BSc and MSc level) and post-graduates (PhD students) are not familiar with the very concept of non-linear processes, or oscillatory reactions. There are two main reasons of this general unawareness. One reason is still low popularity of non-linear thermodynamics, even in the so-called learned communities. Another reason is still insufficiently well performing analytical tools, often unable to carry out rapid enough and/or continuous measurements. Without an awareness of a possible occurrence of non-linear processes and in most cases, using inadequate measuring tools, an average chemist is not watchful enough to perceive non-linear phenomena, even if they take place in front of his eyes. Thus, non-linear changes of measured data are more readily attributed to the apparatus failure than to a discovery of a new non-linear process.

The most easy to discover non-linear phenomena are those which can be recorded with human eye (e.g., color change, like in the Byelousov-Zhabotinsky (BZ) reaction), or with other human senses. Relatively easy to discover are these processes which include an oxidation / reduction step, and hence, can be traced with use of reliable potentiometric methods. The most difficult to discover are non-linear processes running in colorless media, and without an oxidation / reduction or another easily measurable effect.

My presentation will be devoted to a discovery in our lab of a new class of non-linear processes occurring with chiral low molecular weight carboxylic acids (e.g., with profen drugs, hydroxy acids, and amino acids), which take place both in aqueous and non-aqueous media. These processes consist of spontaneous oscillatory chiral conversion and spontaneous oscillatory condensation, and they have been discovered with use of simple chromatographic techniques (thin-layer chromatography, TLC, and high-performance liquid chromatography, HPLC). Different implications of these non-linear processes will also be addressed. In the case of chemical instability of drugs, a question mark is posed on their curative effect and safety. Chemical instability of amino acids and peptides has many different implications, including bionanotechnology and an evolutionary perspective also.

Most important papers from our research group in the field of non-linear processes:

- (1) M. Sajewicz, M. Gontarska, Ł. Wojtal, D. Kronenbach, M. Leda, I.R. Epstein, T. Kowalska, "Experimental and model investigation of the oscillatory transesterification of *L*- $\alpha$ -phenylalanine", *J. Liq. Chromatogr. Relat. Technol.*, **31**, 1986-2005 (2008)
- (2) M. Sajewicz, R. Wrzałik, M. Gontarska, D. Kronenbach, M. Leda, I.R. Epstein, T. Kowalska, "In vitro chiral conversion, phase separation, and wave propagation in aged profen solutions", *J. Liq. Chromatogr. Relat. Technol.*, **32**, 1359-1372 (2009)
- (3) M. Sajewicz, M. Matlengiewicz, M. Leda, M. Gontarska, D. Kronenbach, T. Kowalska, I.R. Epstein, "Spontaneous oscillatory in vitro chiral conversion of simple carboxylic acids and its possible mechanism", *J. Phys. Org. Chem.*, **23**, 1066-1073 (2010)
- (4) M. Sajewicz, M. Gontarska, D. Kronenbach, M. Leda, T. Kowalska, I.R. Epstein, "Condensation oscillations in the peptidization of phenylglycine", *J. Syst. Chem.*, **1**:7 (2010); DOI:10.1186/1759-2208-1-7
- (5) M. Sajewicz, M. Dolnik, D. Kronenbach, M. Gontarska, T. Kowalska, I.R. Epstein, "Oligomerization oscillations of *L*-lactic acid in solutions", *J. Phys. Chem. A*, **115**, 14331-14339 (2011)
- (6) M. Sajewicz, M. Dolnik, T. Kowalska, I.R. Epstein, "Condensation dynamics of *L*-proline and *L*-hydroxyproline in solution", *RSC Advances*, **4**, 7330-7339 (2014)
- (7) A. Godziek, A. Maciejowska, E. Talik, R. Wrzałik, M. Sajewicz, T. Kowalska, "On spontaneously pulsating proline-phenylalanine peptide microfibers", *Curr. Prot. Pept. Sci.* (accepted)

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MSc: 1968

PhD: 1972

British Council scholar (post-doc) at the Department of Chemistry, University of Salford, Salford, Lancs., UK (one academic year, 1974-75)

DSc (habilitation): 1989

Full professor: 2000

Supervisor of ca. 100 MSc students and 14 PhD students

Author and co-author of ca. 300 research papers and ca. 500 conference papers

Editor of four monographs in the field of liquid chromatography with CRC Press:

- (i) "Preparative Layer Chromatography"; Chromatographic Science Series, Vol. 95 (2006)
- (ii) "Thin Layer Chromatography in Chiral Separations and Analysis"; Chromatographic Science Series, Vol. 98 (2007)
- (iii) "Thin Layer Chromatography in Phytochemistry"; Chromatographic Science Series, Vol. 99 (2008)
- (iv) "Planar Chromatography – Mass Spectrometry"; Chromatographic Science Series (currently edited)

Reviewer on an everyday basis for many scientific journals

External examiner for over 40 PhD dissertations at home and abroad

Editor and editorial board member for several international chemistry journals

Engaged in the non-linear chemistry research from 2003