

**D-AMINO ACIDS: A NEW FRONTIER IN AMINO ACIDS AND PROTEIN RESEARCH – PRACTICAL METHODS AND PROTOCOLS**

*Edited by*

**R. Konno, H. Brückner, A. D'Aniello, G. Fischer, N. Fujii, H. Homma**

ISBN 1-60021-075-9

Nova Science Publishers, Inc., New York, 2007.

Web site: <http://www.novapublishers.com>

Gyula Pályi<sup>a</sup>, Claudia Zucchi<sup>a</sup>, and Luciano Caglioti<sup>b</sup>

<sup>a</sup> Department of Chemistry, University of Modena and Reggio Emilia,  
Via Campi 183, I-41100 Modena, Italy. E-mail: [palyi@unimo.it](mailto:palyi@unimo.it), [zucchi@unimo.it](mailto:zucchi@unimo.it)

<sup>b</sup> Department of Chemistry and Technology of Biologically Active Compounds, University "La Sapienza"-Roma,  
Ple. A. Moro, 5, I-00185 Roma, Italy.  
E-mail: [luciano.caglioti@uniroma1.it](mailto:luciano.caglioti@uniroma1.it)

Natural sciences evolve in a cyclic manner: research results first lead to a *thesis*, additional, more refined measurements often show, that also the *antithesis* should be considered. Research dealing with natural amino acids is an excellent example of this kind of evolution of results and ideas. First, it has been established that proteins are polymers of amino acids, secondly (to a great surprise of scientists) it turned out that natural amino acids occur only as one enantiomer (L-), which led to the concept of "biological homochirality" (E. Fisher, end 1800-early-1900), third, evolution in analytical methods showed that some living organisms do contain also the opposite (D-) enantiomers of amino acids. It turned out later (last two decades) that this is a fairly general phenomenon and D-amino acids are present in many (perhaps all) living organisms. This turning point was characterized by a decision made by scientists at the 1st Interdisciplinary Symposium on Biological Homochirality (1998, Serramazzone, Italy), to change name, using instead of "Homochirality" only "Chirality" in the name of the future meetings.

Analytical results on the presence of D-amino acids in many living organisms raised the question whether these are only "contaminations" of these species or have definite biological role. The answer came step-by-step: first it has been discovered that these D-enantiomers have a role in defense mechanisms (cell wall, venoms) as agents which are "alien" to other organisms, soon after it has been found, that D-amino acids have also other specific biological roles, one could say behind the large quantities of the L-enantiomers a "subculture" of the D-isomers is present, acting to solve well-defined biochemical tasks. These results induced research in enzymology leading to the discovery of several enzymes producing or metabolizing D-amino acids.

Today, we can say, a new field has been evolved: the chemistry and biochemistry of D-amino acids. The Editors of the present book are leading personalities of the efforts to obtain and interpret that enormous amount of work, which had been done to arrive to this paradigm change.

There were some earlier efforts to account for the scientific development concerning D-amino acids (e.g. 1-6) and related enzymology (e.g. 7-10), but these could not cover the immense amount of material accumulated. The present book is the first all-round enterprise in this new sector and at the same time it demonstrates with its size and broad scientific coverage the birth of a new science, that of the D-amino acids.

The book is composed of 629 pages, 68 Chapters divided in 6 Sections and contains a useful Subject Index.

Section 1 contains only one Chapter, the brilliant essay of Kenji Soda of Kansai University (Japan), an Author who made several important discoveries in the last decades on the field of D-amino acid enzymology.

Section 2 (16 Chapters) is dedicated analytical methods. These are mainly chromatographic techniques but Chapters on derivatization or on enzymatic analysis are also present. Continuous development in analytical techniques made possible the fast development in D-amino acid biochemistry, thus for scientists who wish to start new research in this promising field this Section is of utmost importance. Detailed description of frontier techniques will facilitate the efforts of these scientists. Section 2 contains also „hot" topics, as the reports on N-methyl-D-aspartate and-D-glutamate (NMDA, NMDG) analysis.

Section 3 (16 Chapters) describes the results on free D-amino acids in animal tissues and on their physiological role. This field is in fast evolution and brought highly interesting results in the past few years. The reports in this Section represent the most challenging aspect of D-amino acids: the formerly unsuspected, well-defined biological roles of these agents.

Section 4 (4 Chapters) discusses a very practical point of D-amino acid biochemistry: the determination of these compounds in foods and the nutritional aspects, which are of particular importance in all foodstuffs, (entirely or partially) obtained by fermentation methods. The necessity of D-amino acid analysis in foods was one of the most

important driving forces of the development of suitable sensitive and specific analytical techniques, which then found applications in related basic research.

Section 5 (10 Chapters) deals with those D-amino acids in living organisms which are bound into proteins. This Section covers several highly important topics, ranging from medical problems of eye aging to (suspected) connections with Alzheimer's disease. These studies led also to some fundamental discoveries of general significance, as for example the role of chiral spaces generated by all-L-protein chains in the biosynthesis of D-amino acids.

Section 6 (21 Chapters) is dedicated to enzymes involved in the biosynthesis and metabolism of D-amino acids. The results reported in this section are of fundamental importance for *in vitro* studies (and also for preparative work) with D-amino acids as well as bear importance for basic and applied enzymology. The presence or absence of such enzymes in living organisms can provide a new and independent source of information about taxonomic relationships and other fundamental problems of biological evolution. On the other hand, these results are and can be in the future starting points of new biotechnological syntheses.

**Summarizing the opinion of the Reviewers:** the book is of landmark importance in biochemistry, announcing the birth of a new discipline as well as of great practical utility for those scientists who are active in, or who intend to start with D-amino acid research.

A book review must not overlook some aspects which can be criticized. First of all, an index of all (many) Authors together with their detailed postal addresses could have been useful, at the present stage only one Author per Chapter could be addressed personally and also these only by e-mail. One should note, that some typing errors survived, e.g. ref. 20 on p. 605 (the title of the book cited is lacking). A Chapter on D-amino acid containing opioid peptides could have been added to complete the picture. These are, however, remarks of minor significance, what really important is that a group of scientists (the Editors and the Authors) made a (first) systematic attempt to gather all available information about a new and important field of biochemistry.

#### References

1. Meister, A. Biochemistry of the Amino Acids, (2nd Ed.), pp. 113-118, Academic Press, New York, 1965.
2. Man, E. H. and Bada, J. L. Dietary D-amino acids, *Annu. Rev. Nutr.*, 7, 209-225, 1987.
3. Jolles, P. (Ed.) D-Amino Acids in Sequences of Secreted Peptides of Multicellular Organisms, Birkhäuser Verl., Basel, 1998.
4. Nagata, Y. D-amino acids in nature, pp. 271-283, in Palyi, G., Zucchi, C., Caglioti, L., Eds., *Advances in BioChirality*, Elsevier, Amsterdam, 1999.
5. Friedman, M. Chemistry, nutrition, and microbiology of D-amino acids, *J. Agric. Food Chem.*, 47, 3457-3479, 1999.
6. Fujii, N. D-amino acids in living higher organisms, *Origins Life Evol. Biosph.*, 32, 103-127, 2002.
7. Soda, K. and Esaki, N. Pyridoxal enzymes acting on D-amino acids, *Pure Appl. Chem.* 66, 709-714, 1994.

8. Pilone, M. S. D-amino acid oxidase: new findings, *Cell. Mol. Life Sci.* 57, 1732-1747, 2000.
9. Asano, Y. Overview of screening for new microbial catalysts and their uses in organic synthesis – selection and optimization of biocatalysts, *J. Biotechnol.* 94, 65-72, 2000.
10. Fujii, N. Ed., Special issue on D-amino acids, *Viva Origino* 30, 182-228, 2002.



Although compounds other than proteins and amino acids also give positive reactions, standard procedures used in the analysis can make the reaction a positive test for amino acids and proteins. Procedure. Dissolve the contents of the vial marked "gelatin" in 100 mL water. Get this protocol in PDF format. Just download this "Color Reactions of Amino acids" file and make a print and distribute to the students. It helps you to protect your students from spelling mistakes and volumetric errors. All the best. Amino acids are zwitterions that include both amino and carboxyl groups in its structure. Therefore, the higher the acidity of amino acid (the more likely it is to form anion) during the cation exchange, the faster the elution, whereas the higher the basicity of amino acid (the more likely it is to form cation), the slower the elution. By the way, though reversed-phase is currently the main method used for HPLC, why is cation exchange used? Cation exchange is used because it is able to easily and efficiently separate amino acids from each other and separate them from substances containing amin...