



Editorial

The significance of D-amino acids in the homochiral world of life



The homochirality of the L-amino acids is essential for the development and maintenance of life. D-Amino acids, enantiomers of L-amino acids, have long been defined as unnatural amino acids in life science and there has been little study of the presence and function of D-amino acids. However, D-amino acids have been recently found in various living higher organisms in the free form as well as in peptides and proteins. Free D-serine and D-aspartate function as a glutamatergic synaptic modulator in our brain. In addition, D-aspartate plays important roles in the regulation of hormonal production and secretion. The enzymes related to the synthesis and metabolism of these D-amino acids are present in living systems. In peptides, D-amino acids are well known as essential amino acid residues of opioid peptides and neuropeptides. In proteins, D-aspartate residues increase during aging and the age-related diseases, such as cataract and Alzheimer diseases, and the hot spots of D-aspartate in proteins were found. These studies involving D-amino acids have been accomplished by the recent improvements in the analysis of amino acid enantiomers, which now enable us to detect them even at femtomole levels.

D-Amino acids are no longer “unnatural” amino acids. However, the following questions are still left; What is the origin of the D-amino acids in our living body? What is the physiological significance of the D-amino acids in the living body? What happens by the appearance of D-amino acids? To answer the questions, the conferences of International D-Amino Acid Research (IDAR) have been held in every several years since 2009 and we have discussed about these questions. The recent conference, named IDAR 2019 was held in September 10–13, 2019, in Tokyo, Japan and important results with significant progress in D-amino acid research were presented there. The next conference, named IDAR 2022 will be held in August 2022 in Urbana, USA. If you become intrigued by the exciting research presented here, consider joining us in 2022 in Illinois, USA.

This special issue includes a collection of 27 articles that contain some of the exciting research presented at IDAR 2019 and includes the new results of D-amino acid research in life science, chemistry, biology, medicine, neuroscience, pharmacology, measurement science and computational science.

The articles appear in order of the study of 1) free D-amino acids, the related enzymes, and the development of the D-amino acid analysis, 2) bound D-amino acids in peptides, 3) bound D-amino acids and their generation mechanism of in proteins in this special issue. You will find several sentence highlights of the research in these articles and encourage you to learn more by reading the articles themselves.

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under COVID19 was not possible without their efforts.

Biography of Noriko Fujii



Dr. Fujii earned her doctorate in biochemistry at Tokyo Medical and Dental University in 1982. She was first an instructor at University of Tsukuba from 1980 to 1991. She has worked as a research scientist at several organizations that include: Takeda Chemical Industries, Group of Field and Reaction, Precursory Research for Embryonic Science and Technology (PRESTO), Japan Science and Technology Corporation (JST), and National Institute for Advanced Interdisciplinary Research (NAIR). She continued to advance in her scholarly career as an associate professor of Kyoto University in 1998 and later as a full professor in 2002. Prior to currently serving as an Emeritus Professor, she successfully managed a donated laboratory for three years. Her research elucidates the relationships between D-aspartyl (D-Asp) residues in proteins and protein aggregation, D-Asp formation, and age-related diseases such as cataracts and Alzheimer's disease. Her research goals require improved analytical approaches and so a second thrust creates enhanced methods for the analysis of isomers and epimers of Asp residues in proteins using liquid chromatography / mass spectrometry. Her efforts are at the forefront of the characterization of posttranslational modifications in human tissue.

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Biography of Hiroshi Homma

Dr. Homma gained B-Sc (1977) and Ph.D. (1982) degrees from The University of Tokyo, Tokyo, Japan. After training as a postdoctoral fellow at The University of Tokyo and The University of Texas, Texas, USA, he was appointed as Assist. Professor and Assoc. Professor at Kyoritsu College of Pharmacy and The University of Tokyo, respectively. He became Professor at Kitasato University (2000), had been Dean, School of Pharmacy and Vice president, Kitasato University. He is currently Professor Emeritus. His research interests focus on elucidation of physiological functions of D-amino acids in animals as well in plants through studying molecular biology of metabolic enzymes specific to D-amino acids and analyzing the contents and localization of D-amino acids in the organisms.

Biography of Alessandro Usiello

Dr. Usiello is currently Full Professor in Clinical Biochemistry and Clinical Molecular Biology at the University of Campania "Luigi Vanvitelli" (Caserta, Italy). He graduated in Biological Sciences at the University of Rome "La Sapienza" (Rome, Italy) and earned a PhD in Molecular Biology at the Institut de Génétique et de Biologie Moléculaire et Cellulaire (IGBMC), in Strasbourg (France). He performed a post-doc in Molecular Neuropharmacology at the Karolinska Institutet, Stockholm (Sweden). Dr. Usiello started his independent scientific career in 2006 at CEINGE Biotecnologie Avanzate, where he established a laboratory devoted to Translational Neuroscience studies. The work of his research group is mainly focused at deciphering the role of D-amino acids as modulators of NMDA receptor-mediated signaling in both animal models and humans, with the long-term goal of understanding and treating neurological and psychiatric disorders associated with glutamatergic dysfunctions. At present, Dr. Usiello is Councillor for the Italian Society of Neuroscience (SINS).

Biography of Jonathan Sweedler

Dr. Sweedler is currently the James R. Eiszner Family Endowed Chair in Chemistry and the Director of the School of Chemical Sciences at the University of Illinois at Urbana-Champaign, and has appointments in Neuroscience, Molecular and Integrative Physiology, Bioengineering and Medicine. His research interests focus on assaying individual cells and other small volume samples for their small molecule and peptides using a range of separations and mass spectrometry approaches. He and his group have uncovered novel neurotransmitters and neuro-modulators, including unusual D-amino acids, neuropeptides and other cell-cell signaling molecules. He is currently the Editor-in-Chief for *Analytical Chemistry*.

Biography of Kenji Hamase

Dr. Hamase graduated from The University of Tokyo and obtained his Ph.D. degree in 1996. Subsequently, he moved to Kyushu University, and was promoted to the full Professor in 2016. He received The Japan Society for Analytical Chemistry Award for Young Scientists in 2003, The Pharmaceutical Society of Japan Award for Young Scientists in 2006 and The Society for Chromatographic Sciences Award (Japan) in 2019. His current research interests focus on the development of analytical methods for chiral amino acids and the study on their physiological functions, diagnostic values and the design of functional foods.

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