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EDITORIAL

Amino acid analysis: current topics and trends

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The history of amino acids begins with the discovery of aspartic acid in asparagus sprouts in 1806. Thereafter, various naturally occurring amino acids of more than 360 species were detected from living organisms. Amino acid analysis was first performed by a postcolumn derivatization method using ninhydrin, which was originally developed by Moore and Stein [1]. They analyzed 124 amino acids and the ribonuclease structure using an automatic and systematic analyzer, and were awarded the Nobel Prize in Chemistry in 1972. Amino acid analysis is an integral part of analytical biochemistry. Amino acid analysis generally includes derivatization, i.e., precolumn, on-column, and postcolumn, coupled with chromatographic separation. A wide variety of separation techniques, including ion-exchange chromatography, reversed-phase chromatography, hydrophilic interaction chromatography, gas chromatography, capillary electrophoresis, and microchip electrophoresis, have been used. Various detection techniques, such as ultraviolet–visible, fluorescence, chemiluminescence, and electrochemical detection, have also been developed for amino acid analysis. On the basis of recent advances in the software and hardware used in mass spectrometry (MS), the variety of amino acid analysis methods has dramatically evolved and use has shifted to various types of MS detection techniques. In the meantime, a number of relatively old techniques, based on derivatization and conventional separation, have acquired a new look. On the basis of these observations, The Japan Society of Amino Acid Analysis (JSA3) was established in the autumn of 2011 to promote and follow the bioanalytical and/or technological advances relating to analysis of amino acids and related molecules.

Various labeling techniques using ultraviolet–visible and fluorescent reagents are still used for the trace analysis of amino acids by the combination of chromatographic separation and MS detection. Of course, electrospray ionization MS allows the analysis of underivatized amino acids. Another new aspect is high-throughput analysis, such as the use of a high-pressure liquid-chromatographic system such as ultraperformance liquid chromatography using a sub-2-μm particle column, and miniaturization analysis such as the use of a microfluidic system. However, the most important issue in amino acid analysis today seems to be in the context of metabolomics studies as part of systems biology. Besides, naturally occurring D-amino acids, such as D-serine and D-aspartic acid, were found in a wide variety of living organisms, both in their free form and as isomeric residues in many peptides. Their detection is due to the tremendous advances in the analytical techniques in recent years. Stereoselective metabolism of amino acids has also been gradually unveiled, and D-amino acids are now considered as novel physiologically active substances and biomarkers even in mammals. In view of the growing importance of the enantioselective analysis of amino acids, articles related to D-amino acid analysis are provided in this issue. Several articles regarding the enantioseparation of DL-amino acids by direct methods using a chiral stationary phase column are also provided.

This topical collection covers a broad range of amino acid analysis, with contributions from the most prominent researchers in the field. The review articles are focused on the analytical methods applied to amino acids and related molecules using liquid chromatography, capillary electrophoresis, and microchip electrophoresis. The topics of the original research articles are expanded to the research field of peptides and proteins. Clarification of both the quantity and the distribution of amino acids in biological samples, including physiological fluids and foods, is also presented. Several research articles describe new methods of amino acid analysis, such as the use of a pillar column and a novel immunometric assay. This topical collection is focused on analysis of amino acids, including peptides, and provides a glimpse of the current research activity in the field.

As a guest editor, it is my pleasure to present this collection of research articles and critical reviews which address the many challenging areas of amino acid analysis, including chiral recognition. Thanks are due to all of the authors for their excellent and timely contributions as well as the editorial staff of

Published in the topical collection *Amino Acid Analysis* with guest editor Toshimasa Toyo'oka.

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Analytical and Bioanalytical Chemistry for their invaluable help in the preparation of this issue. I hope all readers enjoy reading the articles presented here, and look forward to progress in the area of amino acid analysis, including analysis of bioactive peptides and proteins. I believe that this topical collection will be a useful milestone and a guideline both for scientists and for students in this research field.

References

1. Nobel Media (2013) The Nobel Prize in Chemistry 1972. Accessed 11 Jul 2013. http://www.nobelprize.org/nobel_prizes/chemistry/laureates/1972/

Toshimasa Toyo'oka is a full professor in pharmaceutical sciences and Dean of the Graduate School at the University of Shizuoka, Japan. His general studies are the analysis of bioactive molecules by a highly sensitive and selective determination method. His current research interests are in the fields of the development of new chiral derivatization reagents for various functional groups, new analytical methods including high-throughput separations (ultra-performance liquid chromatography, capillary electrophoresis, etc.), highly sensitive detections (fluorescence, mass spectrometry, etc.) of biomolecules, and metabolite profiling of noninvasive samples (saliva, hair, etc.).