

1. 1983 Meeting and General Assembly

Hostellerie Rigi, 6356 Rigi-Kaltbad (LU), October 21-22, 1983.

Programme and Abstracts

Friday, October 21

Chairman : H. Milon, Orbe

14.30 H. Milon, Orbe
Welcome to the participants

14.30 D. Henneberg, Mühlheim/Ruhr, GFR
"Search for Identical and Similar Compounds In Mass Spectral Data Bases".

15.30 J. Seibl, Zürich
"FAB, first practical experience"

16.15 Coffee-break

16.45 W. Richter, Basel
"Two-dimensional Mass Spectrometry Applied to Problems in Structure Analysis. Characterization of Anhydrotrichopolyn, a Trichopolyn Congener Isolated from Trichoderma Polysporum".

17.30 W. Vetter, Basel
"Derivatization, an ancillary technique in mass spectrometry".

18.15 GENERAL ASSEMBLY

19.30 Aperitif, dinner

Saturday, October 22

Chairman : R. Houriet, Lausanne

08.30 G. Karlaganis, Berne
"Identification of 27-nor 5 β -cholestane-3 α , 7 α , 12 α , 24,
25-pentol in man"

08.50 B. Hasler, Zürich
"Simultaneous Determination of Different Trichothecene
Mycotoxins in Food by Combined Gaschromatography-
Massspectrometry".

09.10 B. Domon, Lausanne
"Mass spectrometry of underivatized naturally occurring
glycosides"

09.30 F.B. West, Zürich
"Positive and Negative Ion Mass Spectrometry of some
Glycosides : A Comparative Study by FAB and DCI."

09.50 U.P. Schlunegger, Berne
"Quantitative MS/MS : Determination of trace compounds and
profiling of homologues in Biological Matrices by B²E
linked scans".

10.10 Coffee-break

Chairman : W. Vetter, Basel

10.40 G. Klass, Fällanden/ZH
"The CMS-47 ion cyclotron mass spectrometer : Introduction
and application to the study of some underivatized sugars"

11.00 D. Stahl, Lausanne
"Determination of the Ionization Energy of Ions by Charge-
stripping Mass Spectrometry".

11.20 R. Houriet, Lausanne
"The gas phase basicity of organic molecules"

- 11.40 J. Dennemont, Genève
" On ion formation during laser induced ionisation"
- 12.00 J. Dannacher, Basel
"The study of ionic fragmentation by photoelectron-photoion coincidence spectroscopy"
- 12.20 W. Vetter, Basel
Concluding remarks

ACKNOWLEDGEMENTS

The organizers wish to express their thanks to the following firms for their financial support :

Hewlett -Packard, Widen (CH)	Apéritif
Kratos, Karlsruhe (GFR)	
Nermag, Rueil-Malmaison (F)	
Spectronex (Finnigan MAT), Basel (CH)	Coffee breaks
Spectrospin, Fällanden/ZH (CH)	Coffee and liqueurs
VG Instruments, Wiesbaden, GFR	

2. GACHI

A new Group has been formed at the Lausanne Federal Institute of Technology in the field of Analytical Chemistry :

Groupe de Chimie Analytique à l'EPF-Lausanne

L'année 1983 a vu la naissance du Groupe Analyse Chimique Interdisciplinaire à l'EPFL, GACHI. Les objectifs premiers du groupe sont les suivants :

- créer une structure interne
 - promouvoir les contacts à l'intérieur et à l'extérieur de l'EPFL
 - organiser des journées à thème, des visites de laboratoires
 - entretenir les relations par le biais d'une feuille de contact :
- GACHINFO

Les personnes intéressées sont priées de contacter :
R. Houriet, Institut de Chimie Physique EPFL, 1015 Lausanne,
tél. (021) 47 31 17.

3. Meeting announcements

*Journées franco-suissees de Spectrométrie de Masse,
Lausanne, March 28-29, 1984*

*This two-day meeting will be devoted to FT-MS and MS-MS.
A workshop on FT-MS will be organized.*

*The preliminary announcement and registration form were
recently sent by separate mail.*

*2nd International Conference on Chromatography and
Mass Spectrometry in Biomedical Sciences, Milan,
June 18-20, 1984.*

*This conference is part of the series organized by the
Italian Group for Mass Spectrometry in Biochemistry and
Medicine. The 1st Announcement is joint.*

4. Lecture Announcement

*Prof. D. Henneberg will give a series of lectures organized by
the "Convention Intercantonale Romande pour l'Enseignement du
3ème Cycle en Chimie". They are scheduled as follows :*

Lecturer : *Dr . Dieter HENNEBERG
Max Planck Institut für Kohleforschung
Mühlheim a.d. Ruhr (GFR)*

"COMPUTERIZED HANDLING AND COMPARISON OF MASS SPECTRA"

Berne : *Institut de chimie organique, Freiestrasse 3,
Auditoire S 481.*

Monday, October 24, 16.15 h.

*"Correction methods for background
and overlap in spectra series"*

Tuesday, October 25, 16.5 h.

*"Quotient spectra as a tool for the
comparison of mass spectra regarding
the influence of measurement condi-
tions and mixture components".*

Wednesday, October 26, 16.15 h.

*"Content and quality of spectra
collections, maintenance and control".*

Neuchâtel : Institut de chimie, Av. de Bellevaux 51,
Petit Auditoire.

Tuesday, October 27, 17.15 h. "Constituents and working principles
of a search system combining the
retrieval of identical and similar
compounds"

Genève : Institut de chimie, 30, quai Ernest Ansermet,
Bâtiment Science II, Salle A 50.

Friday, October 28, 15.30 h. "General and practical aspects of the
evaluation of low resolution spectra
series".

5. News from other Associations

From April 20, 1983, P.A. Leclercq retired as chairman of the
Mass Spectrometry Discussion Group of the Royal Dutch Chemical
Society. The new board is composed of :

Ir. M.C. ten Noever de Brauw (chairman / secretary)
CIVO-TNO, Utrechtseweg 48, 3704 HE Zeist.
Tel. 03404-52244

Dr. J. Vink (member)
Organon International b.v., Analytical R & D Labs, P.O. Box 20,
5340 BH OSS
Tel. 04120-62999

Dr. A.P. Bruins (member)
State University of Groningen, Pharmaceutical Labs, Anthonius
Deusinglaan 2, 9312 AW Groningen.
Tel. 050-116162.

Search for Identical and Similar Compounds in Mass Spectral Data Bases.

D.Henneberg MPI für Kohlenforschung, Mülheim/Ruhr

The determination of molecular structures can be achieved or supported by library search. Such a search consists in comparing a mass spectrum of the unknown sample or compound with the spectra of a library and selecting the best matches to be presented in a hitlist. If spectra of identical and/or similar compounds are retrieved, then identifications can be recognized or established, or the presence of certain substructures and functional groups of the unknown molecule can be predicted. The use of a comprehensive library increases the evidence of the results especially if a search retrieves similar compounds.

The retrieval of a certain spectrum must be fairly independent from the typical deviations resulting for mass spectra measured under different conditions. Furthermore, a search must often be carried out with spectra of mixtures or contaminated compounds or with spectra of compounds which are not represented in the library. Finally, a comprehensive library is inhomogeneous with regard to content and quality of the spectra due to the different origin of the data.

To meet the requirements of all these complications, it is not sufficient to select the members of the hitlist by means of the identity of the patterns of unknown and references. Most spectra containing information that may be relevant to the interpretation of the analysis and which therefore should appear in the hitlist, will deviate more or less from the unknown spectrum. The best result for a search is therefore obtained if the comparison of the unknown and the reference spectrum is capable to detect particularly those similarities between spectra which reflect similarities between structures.

This will be demonstrated, showing the response of different search methods to certain examples. For the search method SISCO, the principles used to achieve the required retrieval of spectra of similar and identical compounds are described in some detail.

Recently, first results have been obtained in developing a particular measure for identity. This identity measure uses the full, unreduced spectra and determines the pattern identity on the basis of quotient spectra which allows to eliminate the influence of skewing and, to a certain extent, the influence of instrumental conditions on the patterns.

FAB, first practical experiences

J. Seibl ETH Zürich

Summary

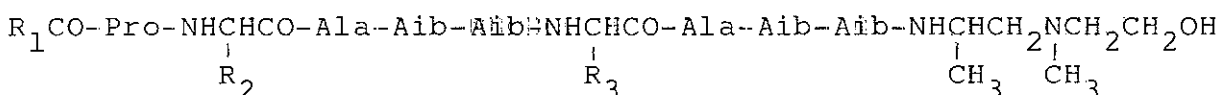
An informal survey of practical aspects of FAB analysis is presented, dealing with features of instrumental behaviour, sample handling, choice and effects of different matrix materials, scope of obtainable structural information from several compound types and apparently typical reactivities. The discussion reflects personal impressions after 1½ year of analytical application of the new method in a specific local chemical environment and is intended to contribute to the general knowledge about this topical subject for interested mass spectroscopists.

Two-dimensional Mass Spectrometry Applied to Problems in Structure Analysis. Characterization of Anhydrotrichopolyn, a Trichopolyn Congener Isolated from Trichoderma Polysporum.

J. M. Müller, F. Raschdorf and W. J. Richter, Ciba-Geigy AG, CH-4002 Basle.

In our screening of micro-organisms for new compounds of potential therapeutic use, trichopolyn B was isolated from several fungal strains of Trichoderma polysporum (Moniliales). This antifungally active antibiotic has been isolated before by Japanese research groups and was later found to consist of two peptide constituents, trichopolyn I and II (9:1 mixture). By spectroscopic means and extensive chemical degradation the structures were shown to be 1 and 2 ($C_{61}H_{111}N_{11}O_{13}$, $M = 1205$ and $C_{60}H_{109}N_{11}O_{13}$, $M = 1191$), respectively.

In our bioautograms a less polar congener with similar biological activity was frequently observed in very low concentration (<1 %). In view of the expected close structural relationship to the parent and, especially, of the limited amounts of material available, a comparative MS-study appeared to be the method of choice. On subjecting the (composite) congener to fast atom bombardment (FAB) and two-dimensional mass analysis (MS/MS), structure 3 and 4 ($M = 1187$ and 1173 , respectively) could be deduced for the chief components.



$R_1 = n-C_8H_{17}CH(CH_3)-$ in 1 - 4; $R_2 = C_2H_5COCH_2CH(OH)CH_2CH(CH_3)CH_2-$ in 1 and 2, yet $C_2H_5COCH=CHCH(CH_3)CH_2-$ in 3 and 4; $R_3 = C_2H_5CH(CH_3)-$ in 1 and 3, yet $(CH_3)_2CH-$ in 2 and 4; Aib = α -aminoisobutyric acid.

Thus, a formal loss of H_2O with formation of a conjugated enone moiety within the alkyl substituent R_2 is found to constitute the sole structural difference to the parent molecule. Like in the latter the duplicity of a major and a minor component is due to the replacement of isoleucine by valine in the central portion of the peptide chain.

Derivatization, an ancillary technique in mass
spectrometry

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W. Vetter, Hoffmann-La Roche & Co, CH-4002 Basle

Functionalized long chain molecules often do not show analytically useful fragmentation patterns of their chains in the mass spectra. For example, the position of a double bond cannot be deduced from the mass spectrum of a fatty acid or an alcohol.

Some time ago it was discovered that the mass spectra of tertiary amides show a fragmentation pattern of the chain, which exhibits many features of the structure, including the position of a double bond.

The merits and the deficiencies of the commonly used derivative, the pyrrolidide, will be discussed. Analogous derivatives will be presented and the criteria, which must be met, will be outlined.

Identification of 27-nor-5 β -cholestane-3 α ,7 α ,12 α ,24,25-pentol in man

G. Karlaganis, V. Karlaganis and J. Sjövall

Department of Clinical Pharmacology, University of Berne, 3010 Berne, Switzerland and Department of Physiological Chemistry, Karolinska Institutet, 10401 Stockholm, Sweden

In the course of studies of metabolic profiles of bile acids in urine, a number of polyhydroxylated neutral sterols were detected in a fraction containing glucuronides of neutral steroids. The present study was initiated in order to characterize these sterols.

Following extraction with Sep-Pak C18 cartridges, a glucuronide fraction was isolated by ion exchange chromatography on Lipidex-DEAP (Setchell et al., *J. Steroid Biochem.* 7, 615-629, 1976). The fraction was treated with Helix pomatia intestinal juice, extracted with Sep-Pak C18, and neutral compounds were purified on Lipidex-DEAP. Trimethylsilyl (TMS) ethers of the sterols were analyzed by capillary gas chromatography-mass spectrometry using a persilanized glass capillary column coated with OV 73 (Grob et al., *J. HRC + CC* 2, 677-678, 1979).

While cholestanetetrols and -pentols of the types described by Mosbach and coworkers (Shefer et al., *J. Lipid Res.* 16, 280-286, 1975) were found, the structure of the major compound was unknown. This compound was isolated by reversed-phase chromatography on Lipidex 1000. The mass spectrum (underivatized, direct inlet) showed a peak at m/z 436 (corresponding to M-2 for a C₂₆-pentol) and peaks due to loss of 1, 2 and 3 molecules of water. This spectrum, as well as that of the TMS ether derivate indicated the presence of 3 hydroxyl groups in the ring system and 2 in the side chain. The latter reacted with 2,2-dimethoxypropane to form an acetonide. The TMS ether of this derivative gave an expected molecular ion at m/z 694. Oxidation of the sterol with periodate followed by reduction with LiAlH₄ yielded a cholane-tetrol. The TMS ethers of this product and 5 β -cholane-3 α ,7 α ,12 α ,24-tetrol gave identical mass spectra and retention times. Based on these findings the structure of the new sterol is proposed to be 27-nor-5 β -cholestane-3 α ,7 α ,12 α ,24 ξ ,25 ξ -pentol.

The compound was present in urine from healthy adults and in increased amounts in patients with various liver diseases. Its physiological importance is unknown. There is only one previous report on the occurrence of a C₂₆ sterol in mammals. Thus, Ikekawa et al. identified 27-norcholesta-5,22-dien-3 β -ol in urine of a child with congenital adrenal hyperplasia (*Science* 204, 1223-1224, 1979). The sterol identified by us might reflect the existence of a decarboxylating side reaction in bile acid biosynthesis. Our results indicate that a variety of polyhydroxylated sterols, probably formed in connection with bile acid synthesis, are eliminated as glucuronides in urine.

Simultaneous Determination of Different Trichothecene
Mycotoxins in Food by Combined Gaschromatography-
Massspectrometry

B.Hasler, R.Robbiani, and W.Büchi

CPC/Europe, Quality Assurance Center, Leutschenbachstr.46,
CH 8050 Zürich

Trichothecenes are a group of closely related sesquiterpenoid metabolites formed by various species of Fusarium, Mycopthecium, Trichothecium and Stachybotrys. More than 65 different compounds have so far been structurally identified. The widespread nature of these fungi in cereals, vegetables and other foodstuffs as well as in feed is an indication that the trichothecenes might be one of the most important groups of mycotoxins.

In 1980, the Ontario white winter wheat crop showed a pink coloration on the kernels due to Fusarium infestation. Chemical analysis showed the presence of only one trichothecene mycotoxin in significant amounts: Deoxynivalenol or Vomitoxin. Levels up to 8 ppm vomitoxin were detected in this crop.

These findings initiated a series of survey-programs and methodology for the identification and quantitation of this toxicant has been developed.

In this paper, a method for the simultaneous analysis of seven of the most important trichothecenes is presented. Combined gas-chromatography-massspectrometry was used for the separation and determination of the trichothecene-TMS-derivatives. Results obtained with electron impact ionization in comparison with chemical ionization are discussed.

Mass spectrometry of underivatized naturally occurring glycosides

Bruno Domon and Kurt Hostettmann

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Ecole de Pharmacie de l'Université de Lausanne

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1005 Lausanne

Mass spectrometry using soft ionisation techniques is a method of choice for the structure elucidation of biologically active glycosides, where the available amount of substance is often limited. Soft ionisation methods are of interest in this area since derivatization with all its disadvantages can be avoided. The biological activity is generally depending on the nature of the glycosidic part of the molecule. Determination of the sugar sequence, the sugar linkages as well as the attach positions on the aglycone are of prime importance. Saponins possessing molluscicidal activity, bitter principles and flavonoid glycosides were studied without derivatization using soft ionisation techniques. Desorption chemical ionisation (DCI), fast atom bombardement (FAB), - both techniques in positive and negative modes -, and field desorption (FD) were used.

Structural informations on the molecular weight, the sugar sequence, the nature of the aglycone and in some cases, the substitution pattern of the aglycone could be obtained.

Positive and Negative Ion Mass Spectrometry of some Glycosides:
A Comparative Study by FAB and DCI.

A. Sakushima, F.B.Ch. West and H. Brandenberger,
Department of Forensic Chemistry, University of Zürich,
CH-8028 Zürich, Switzerland.

The mass spectra of some flavanoid glycosides were recorded using:

1. fast atom bombardment in the positive ion mode,
2. fast atom bombardment in the negative ion mode,
3. desorption chemical ionization in the negative ion mode with methane at low pressure as reagent,
4. in-beam desorption in the positive ion mode (electron impact ionization).

Methods 3 and 4 were used combined (quasi-simultaneous) as a dual mass spectrometric technique (1).

With the first three techniques, intensive ions in the molecular mass range and in the aglycone mass range can be observed. In addition, weak sugar moiety fragment anions are detected with Method 3. The aglycone mass and sugar moiety fragment cations are given by Method 4. Our combination of Methods 3 and 4 is therefore a good approach for flavanoid structure elucidation.

(1) H. Brandenberger, Int. Journal of Mass Spectrometry and Ion Physics, 47 (1983) 213-216.

QUANTITATIVE MS/MS:
DETERMINATION OF TRACE COMPOUNDS AND
PROFILING OF HOMOLOGUES IN BIOLOGICAL MATRICES
BY B²E LINKED SCANS

H J WALTHER and U P SCHLUNEGGER, Department of Organic Chemistry
University of Berne, Freiestrasse 3, CH-3012 Berne, Switzerland

and

F FRIEDLI, MSP Mass Spectrometer Products Friedli & Beck,
Bindenhausstrasse 46, CH-3098 Köniz, Switzerland

Usually MS/MS (MIKES and B/E linked scans) is used in testing mixtures for the presence of one special compound. However, very often an interesting compound or even a series of homologue-compounds must be determined quantitatively.

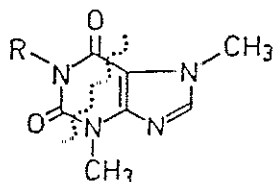
It is shown that the recently developed B²E = constant linked scan (search for precursor ions) [1, 2] offers new possibilities for profiling and quantitations on mass spectrometers with reversed geometry. Due to its much higher precursor ion resolution than the B²/E = constant linked scan, quantitation may be based on internal standards, e.g. deuterium labelled analogues.

Principle: Search for all precursor ions of a preselected fragment ion in the second field free region of a reversed geometry instrument.

The technique is applied to the quantitation of caffeine in beverages and to the profiling of biogenic amines in wine:

1) Caffeine in beverages:

Quantitation of caffeine is based on the internal standard caffeine-d₃. The common fragment ion is at m/z 109.

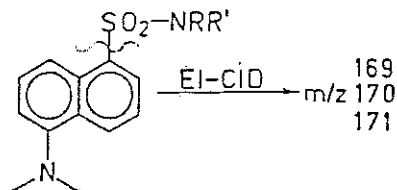


R = CH₃, CD₃

The content of caffeine has been found to be in the range of 100 mg/l in soft drinks ("Cola" drinks), 500 mg/l in black tea, and 900 mg/l in coffee (≈ 40 mg/l in decaffeinated coffee).

2) Biogenic amines in wine:

Dansylated amines are generating a common fragment ion at m/z 169.



Biogenic amines have been dansylated directly in a 0,5 ml wine sample and extracted. The crude extract has been analysed by a B²E precursor ion search, thus yielding a profile of the amines present in the original sample (2-15 mg/l).

Literature: R.K. Boyd, C.H. Porter and J.H. Beynon

[1] Org. Mass Spectrom. 16, 490 (1981).

[2] Int. J. Mass Spectrom. Ion Phys. 44, 199 (1982).

THE CMS-47 ION CYCLOTRON MASS SPECTROMETER:

INTRODUCTION AND APPLICATION TO THE STUDY OF SOME UNDERIVATIZED SUGARS

Dr. G. Klass, Dr. M. Allemann and Dr. Hp. Kellerhals

The CMS-47 mass spectrometer is a new generation Fourier transform ion cyclotron resonance mass spectrometer using a high magnetic field (4.7 Tesla) super conducting magnet.

This instrument possesses a number of unique features, including (i) ultra high resolution and extreme stability, allowing accurate mass measurement in the absence of calibration or reference compounds, (ii) low pressure chemical ionization, (iii) rapid, computer controlled switching from positive to negative ion mode, and (iv) single or multiple ion ejection for the study of ion-molecule reaction pathways.

A number of these features will be discussed as well as the applications of the CMS-47 to a study of a number of underivatized sugars.

Determination of the Ionization Energy
of Ions by Charge-stripping Mass Spectrometry

D. Stahl* and F. Maquin, Institut de Chimie-Physique,
Ecole Polytechnique Fédérale de Lausanne, 1015 L a u s a n n e

Collisions of high velocity ions with a neutral gas molecule can be used for determining their vertical ionization energy. The minimum translational energy loss, Q_{\min} , for the peak corresponding to the charge-stripping reaction $M^+ + N \rightarrow M^{++} + N + e^-$ is given by $Q_{\min} = IE(M^+ \rightarrow M^{++}) - EE(M^+)$, where $EE(M^+)$ represents the excitation energy of the reactant ions M^+ . For M^+ ions in their ground state Q_{\min} equals the vertical ionization energy corresponding to the difference between the double ionization energy and the single ionization energy. Several examples will be given with comparison of the experimental data with results of "ab initio" calculations.

THE GAS PHASE BASICITY OF ORGANIC MOLECULES

Raymond HOURIET, Institut de chimie physique EPFL, 1015 Lausanne

The intrinsic basicity properties of isolated molecules can be determined by the measurement of proton transfer equilibrium reactions in an ion cyclotron resonance (ICR) spectrometer. The effects of substituents on basicity have been studied for several classes of compounds.

In the case of multifunctional compounds, it is necessary to determine both the basicity value and the site of protonation under equilibrium conditions. Thereafter, the determination of the properties of other sites in the system can be attempted in experiments performed under non-equilibrium conditions.

These measurements provide useful results for comparison with the studies of electrophilic substitution reactions.

The following systems will be described:

- C vs N protonation in enamines
- Site of protonation in furan
- N vs O protonation in amino-alcohols and -acids.

ON ION FORMATION DURING LASER INDUCED IONISATION

J. DENNEMONT and J.-Cl. LANDRY

The laser microprobe mass analyser (LAMMA) is now commercially available. Both the absolute detection limit (10^{-20} - 10^{-18} g) and the spatial resolution presume the LAMMA instrument to be suitable for the chemical composition of single aerosol particles. Although it is relatively simple to identify single pure particles the interpretation of spectra of complex composition becomes a more difficult matter.

In view of the speciation of atmospheric particles we have undertaken a systematic study of the fragmentation pattern of some inorganic salts. The positive and negative spectra of nitrates and sulphates of groups I and II of the periodic table will be discussed. During laser induced ion desorption and plasma formation ions seem to be produced by decomposition of the parent molecule and ion-molecule interactions. Predominant neutrals add to ionic species to generate the observed spectra. Evidence will be given in favour of the above mechanism.

Futhermore, it will be shown that on a qualitative basis all nitrates and sulphates of groups I and II can be differentiated from one another by their characteristic ions.

Finally the behavior of complexes of some transition metals after laser induced ionisation will be described.

THE STUDY OF IONIC FRAGMENTATION BY PHOTOELECTRON-PHOTOION
COINCIDENCE SPECTROSCOPY

Josef Dannacher

Physikalisch-Chemisches Institut der Universität Basel,
Klingelbergstrasse 80, 4056 BASEL (Switzerland).

ABSTRACT

One of our most valuable tools to explore the decay processes of excited cations undoubtedly is photoelectron-photoion coincidence spectroscopy. The outstanding reputation of the method is essentially founded on the fact that internal energy selective measurements can be carried out. A decade after the invention of the technique some 150 molecular ions have been investigated and it is worthwhile to recall the most important outcomes which have been obtained. Respecting the interpretation of ionic fragmentation patterns, most recently developed procedures are particularly significant, since a quantitative analysis of the breakdown diagrams of smaller organic cations has been achieved. These newest results provide a solid basis for various concepts which are crucial to the field of organic mass spectrometry.