Ablage

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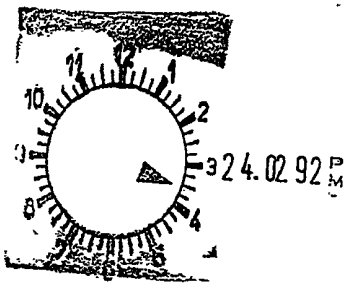
Summary

A Finnigan tandem quadrupole mass spectrometer is required to solve the complex analytical problems we encounter within the scope of our research, e.g., in chemistry, biochemistry, and molecular biology. This versatile system with its wide range of applications is needed for, e.g., the characterization of still unknown phase I and II nicotine metabolites or to determine adducts and conjugates of smoke components. It will greatly extend our analytical capabilities and enable us to rapidly and effectively respond to future research challenges. The standard system includes the tandem quadrupole mass spectrometer as well as a gas chromatograph, electron impact and positive and negative chemical ionization capabilities, and an integrated data system for instrument control and data evaluation. Among the optional features are a thermospray interface for liquid chromatography and the fast atom bombardment capability. Today, such instrumentation is state-of-the-art in analytical chemistry and is in common use in major bioresearch laboratories.



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General remarks

Mass spectrometry has proven to be an indespensable tool in numerous research areas as the demand for efficient and reliable solutions to increasingly complex analytical problems continues to grow. Since the introduction of quadrupole instruments, mass spectrometry has become generally accepted as a versatile, sensitive, and specific method in research and routine use for a multitude of analytical applications. Some of the features that have made quadrupoles so popular are: rapid scanning, relatively small size, simplicicity of operation, and relatively low cost. The same features have made multiquadrupole systems attractive for mass spectrometry/mass spectrometry (MS/MS). Since their commercial introduction in 1978, triple stage quadrupole instruments have come into widespread use in, e.g., pharmaceutical, environmental, and bioresearch laboratories.

Within the scope of our research, an MS/MS will greatly extend our research capabilities as well as enhance efficiency and quality of our analytical work.

Equipment in current use

With the equipment currently in use, important analytical problems resulting from our biological research can only be solved - if at all - with an extraordinary expenditure of time. Since 1985, we have been using a Hewlett Packard mass selective detector (MSD) connected to a capillary gas chromatograph. This instrument is limited to capillary gas chromatography, electron impact (EI) ionization, and a usable mass range of up to approx. 400 to 500 daltons. Although EI spectra provide structural information and allow comparisons to existing mass spectral libraries, such spectra frequently do not provide molecular weight information. The new equipment enables the use of soft ionization techniques such as chemical ionization (CI) to easily obtain molecular weight

information. In addition, the combination of MS/MS with liquid chromatography (LC) considerably enlarges the range of compound classes that can be determined.

Examples of established routine determinations we perform using the MSD are the analysis of polycyclic aromatic hydrocarbons in smoke condensate as well as in mainstream and sidestream smoke, the determination of nicotine and nicotine metabolites in urine and plasma, or the analysis of 1,3-butadiene, isoprene, benzene and toluene in highly diluted sidestream smoke. However, many essential applications in bioresearch are only possible with MS/MS and its versatile operation modes, interfaces, and ionization techniques.

New instrument: Features and advantages

A triple stage quadrupole mass spectrometer provides MS/MS capabilities enabling us to characterize unknowns and to analyze mixtures or impure samples. When coupled to LC, components can be analyzed that are insufficiently volatile to be handled by gas chromatography. The combination of LC and MS significantly extends the range of compound classes amenable to on-line analysis by mass spectrometry. Due to the high specifity provided by the MS, coeluting compounds can be differentiated thereby enhancing the power of HPLC.

The basic instrumentation provides gas chromatography and EI as well as positive and negative CI. The system features thermospray/plasmaspray, fast atom bombardment (FAB), continuous flow FAB, electrospray, or particle beam interfaces as well as auxiliary probes, e.g., liquid-cooled solids and desorption CI probes.

Important advantages of the system are the versatile operation modes like daughter and parent ion scan, neutral loss scan, and

selected reaction monitoring allowing sensitive and selective analyses of a wide range of compounds. The rapid switching capability between the various operation modes provides quick information about target compounds or unknown sample mixtures.

Application examples

With regard to the nicotine biokinetics and metabolism project, the system will be used to characterize phase I and II metabolites. Preliminary, extramurally-contracted thermospray and FAB experiments indicated the occurence of glucuronides and sulfates of nicotine. For characterization of these metabolites, MS and MS/MS experiments are required.

Within the scope of our research, other complex analytical tasks can be worked out using MS/MS, e.g., target compound analyses, biochemical determinations, or characterization of the water soluble smoke fraction. Target compound analysis can be performed, e.g., to rapidly determine trace components in ETS or to screen for compound classes in smoke or condensate. Targets for biochemical analyses are the determination of hemoglobin adducts of tobacco specific nitrosamines, conjugates of smoke components, e.g., glutathione conjugates, and lipid peroxides. With the water soluble smoke fraction various in vitro assays are under development. The characterization of this fraction by LC/MS will provide information on the smoke compounds active in such assays.

Choice of instrument

On the European market there are 2 main companies selling triple stage quadrupoles which come into consideration. The TSQ 700 from Finnigan MAT and the QUATTRO from VG. Both systems offer state-of-the-art-ionization techniques and interfaces. Since Finnigan introduced the first commercially available instrument in 1978,

they have attained worldwide leadership in triple stage quadrupoles. The Finnigan quadrupole systems are known to be solid and well proven for demanding analytical work. Since many reports in literature are based on work done with Finnigan instruments, information exchange with other users is possible.

Brief description of the Finnigan TSQ 700

The standard equipment of the TSQ 700 consists of a switchable EI/CI ion source, dual hyperbolic quadrupole mass filters with a 4000 daltons mass range, and an octapole collision cell. The detector is a continuous dynode multiplier with a +/- 20 kV post acceleration. The vacuum is produced by a differential air cooled turbomolecular pumping system. A multiprocessor network serves for instrument control and data acquisition and processing. It also features a capillary gas chromatograph controlled by the data system.

The standard data system consists of a DECstation 3100 with 16 Mbyte RAM, a 640 Mbyte disk drive, a 95 Mbyte streamer tape, a 16'' high resolution color monitor, and a PostScript laser printer/plotter. The software includes a complete application software package running under a DEC ULTRIX-32 operating system. For optimal efficiency an optional thermospray LC-MS and FAB will be added to the system.

The system specifications can be taken from the attached data sheet.