Gas-Phase Structure and Unimolecular Dissociation of Cysteine Sulfynil Radical Ions

Overview

- Tandem mass spectrometry and ab initio calculations were used to probe the structure and understand gas-phase unimolecular dissociation behavior of small cysteines containing sulfynil radical ions.
- N-acetylation, O-methylation, stable-isotope labeling were used to investigate the structural and energetic information.
- Location of charge significantly impacts charge vs. radical driven fragmentation of sulfynil radical ions.
- Proposed mechanism for the major fragmentation pathways are presented.

Introduction

- Radicals play important roles in biological systems via reactions toward a wide variety of biomolecules. Undesirable chemical modification of biomolecules by OH radical can result in irreversible cell damage or dysfunctions. Irregular concentrations of hydroxyl radical has proven to be related to oxidative stress and aging.8,9
- Sulfur containing amino acid residues, such as cysteine and methionine, are among the most reactive sites toward OH attack.8
- Characterization of the thus formed peptide/protein radical intermediates is a key step to understanding the associated biological consequences.4
- Insight on distonic ions as reactive intermediates for unimolecular mass spectrometric fragmentation.6
- In this presentation, gas-phase cysteine sulfynil radical ions (cations) were formed via oxidative cleavage of disulfide bond within cysteine or modified cysteine ions.

Methods

- NanoESI for peptide ion formation
- Atmospheric pressure helium low temperature plasma (LTP) for hydroxyl radical formation.9
- The interactions between hydroxyl radicals and peptide ions were facilitated in a glass flow tube as shown in Figure 1.
- A 4000Diap mass spectrometer was used for data collection.
- All peptides were prepared in 50:49:1 MeOH:H2O:Ac (v/v/v) with a final concentration of 10 μM.
- Deuterated peptides were prepared as 99.1 (v/v) D2O/acetic acid solutions.

Results and Discussion

- Figure 1. Schematic view of the experimental setup
- N-acetylated cysteine sulfynil radical ions
- Ion trap CID of cysteine and D2-cysteine sulfynil radical ions

Conclusions

- Location of charge plays a role in charge driven vs. radical driven fragmentation of cysteine sulfynil radical ions.
- Reaction on nitrogen resulted in EDDA loss (CH2SO).
- Dominant 51Da product ion loss (H2SO) when cysteinyl sulfynil radical ions are acetylated.
- Loss of H2SO is sequential loss from the initial H2O loss
- Mobile proton, basic carbon-proton, acidic hydrogen ions are involved in H2SO loss

Acknowledgements

- 51Da loss (H2SO)
- Accurate mass: 50.9940Da Theoretical mass: 50.9994Da
- Isotopic Deuterated Labeling
- MS2 CID of H2O loss
- N-acetylated cysteine sulfynil radical ions
- N-acetylated-O-methylated cysteine sulfynil radical ions

References