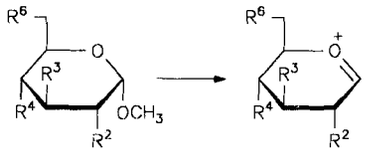
ORGANIC MASS SPECTROMETRY, VOL. 26, 171–172 (1991)

OMS Letters

Dear Sir

Influence of Fluoro Atoms on the Spontaneous and Collision-induced Fragmentation of the Ions $[M - OCH_3]^+$ and $[M + NH_4]^+$ of per-*O*-acetylated Methyl *x*-Deoxy-*x*-fluoro-α-D-glucopyranosides

Deoxyfluoroglycosides are important model substances for studies of hydrogen bonding between ligands and biologically active proteins such as, for example, immunoglobulins. To assist the mass spectral characterization of these monosaccharides, the electron impact ionization (EI) mass spectra and the ammonia chemical ionization ($CI(NH_3)$) mass spectra of the acetates of synthetic[1] methyl *x*-deoxy-*x*-fluoro-α-D-glucopyranosides (**1–4**) (Scheme 1) were obtained.



a_1

Compound	R^2	R^3	R^4	R^6
1	F	OAc	OAc	OAc
2	OAc	F	OAc	OAc
3	OAc	OAc	F	OAc
4	OAc	OAc	OAc	F

Scheme 1

The EI-induced fragmentation of per-*O*-acetylated methyl glycosides has been previously studied by using specifically labelled acetate groups[2] and by using the mass-analysed ion kinetic energy (MIKE), collisional activation (CA) and accelerating voltage techniques.[3] Our results show that the replacement of an acetyl group by a strongly electronegative fluoro substituent in different positions of the monosaccharide has a large effect on the EI and CI fragmentations. In the same way as the 70 eV EI mass spectra of per-*O*-acetylated methyl glycosides,[2,3] the spectra of **1–4** are complicated by the stepwise eliminations of CH_3COOH and CH_2CO. Appearance energy measurements have shown[4] that these eliminations at various stages of the decomposition of the molecular ions require relatively small amounts of energy (13–34 kJ mol^{-1}). In analogy to the per-*O*-acetylated methyl glycosides, the molecular ions of the fluoro derivatives **1–4** react by five different fragmentation routes. A complete fragmentation scheme of **1–4** evolved from the analysis of metastable transitions by various techniques. These results will be discussed in the full paper (in preparation). Here we present the MIKE and CA spectra of the ions $[M - OCH_3]^+$ (a_1, see Scheme 1), derived by EI from the molecular ions of **1–4** by loss of the glycosidic CH_3O group, which clearly reflect the position of the fluoro substituent, and the MIKE and CA spectra of the cluster ions $[M + NH_4]^+$ formed by $CI(NH_3)$ of **1–4**.

The EI spectra were obtained with a VG ZAB 2F mass spectrometer at 70 eV electron energy and an ion source temperature of ca. 180 °C. The oily substances were introduced into the ion source by a heated direct-inlet system and a leak valve. To measure the $CI(NH_3)$ mass spectra, ammonia was introduced into a home-built CI ion source by the CI gas line until the pressure reading at the ion gauge at the ion source housing was 10^{-6}–10^{-5} mbar. The ions under study were focused magnetically into the second field-free region of the ZAB-2F instrument after the magnet and the MIKE spectra were recorded by scanning the deflection voltage of the electrostatic analyser. The CA spectra were obtained by the same technique, whilst He was introduced as the collision gas into the collision chamber of the second field-free region until the peak intensity of the parent ion was reduced to ca. 50%.

The MIKE and CA spectra of the glycosidyl cations a_1 derived from **1–4** (Table 1) show that the main reactions are the eliminations of CH_3COOH and CH_2CO, as expected. Surprisingly, the glycosidyl cation of 3-deoxy-3-fluoro-glycoside (**2**) also eliminates HF. This is a further example of the special effects of substituents at the C(3) position of a glycopyranoside[5] on the mass spectrometric fragmentation. In addition, the intensities of the fragment ions owing to the elimination of CH_3COOH and CH_2CO in the MIKE and CA spectra depend clearly on the position of the fluoro substituent (Table 1). Thus, only the MIKE spectrum of the 2-fluoro derivative (**1**) exhibits a large signal for the loss of CH_2CO at *m/z* 249, whilst the MIKE spectrum of the 4-fluoro derivative (**3**) shows only a large peak for the elimination of CH_3COOH at *m/z* 231. These ions are also formed from the 6-fluoro isomer (**4**) but additionally *m/z* 171 ions due to the loss of two CH_3COOH units are observed. These differences are also observed in the CA spectra of the isomeric deoxy-

Table 1. MIKE and CA (EI) spectra of ions a_1, *m/z* 291, from 1–4

		1		2		3		4	
Ion	*m/z*	MIKE	CA	MIKE	CA	MIKE	CA	MIKE	CA
a_1 – HF	271	—	—	27	7	—	—	—	—
a_1 – CH_2CO	249	61	36	—	—	—	—	—	—
a_1 – AcOH	231	77	25	6	6	100	100	100	86
a_1 – HF – AcOH	211	—	—	8	3	—	—	—	—
a_1 – CH_2CO – AcOH	189	74	100	—	3	—	10	—	43
a_1 – 2AcOH	171	100	93	—	—	—	10	20	86
a_1 – HF – CH_2CO – AcOH	169	—	—	100	100	—	—	—	—
a_1 – CH_2CO – 2AcOH	129	31	90	—	—	—	15	—	100
a_1 – 3AcOH	111	18	20	—	—	—	—	—	—
a_1 – HF – CH_2CO –2AcOH	109	—	—	6	36	—	—	—	—

0030–493X/91/030171–02 $05.00

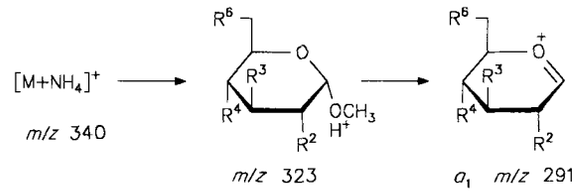
Received 30 October 1990
Revised manuscript received 21 December 1990
Accepted 22 December 1990

Table 2. MIKE and CA spectra (CI(NH_3)) of $[M + NH_4]^+$ from 1–4

		1		2		3		4	
Ion	*m/z*	MIKE	CA	MIKE	CA	MIKE	CA	MIKE	CA
$[M + H]^+$	323	77	8	64	10	76	7	68	24
a_1	291	100	100	100	100	100	100	100	100
a_1 – AcOH	231	—	24	—	25	—	17	—	20
a_1 – CH_2CO – AcOH	189	—	6	—	8	—	4	—	4
a_1 – 2AcOH	171	—	12	—	10	—	8	—	10
a_1 – CH_2CO – 2AcOH	129	—	6	—	6	—	6	—	9
a_1 – CH_2CO – 2AcOH – CH_3OH	97	—	10	—	10	—	6	—	7
CH_3CO^+	43	—	50	—	50	—	33	—	54
NH_4^+	18	—	20	—	20	—	11	—	19

fluoroglycosidyl cations. Hence both types of spectra can be used for an unambiguous determination of the fluoro substituent of per-*O*-acetylated methyl deoxyfluoroglucosides.

As expected,[3,6] the deoxyfluoroglycosides **1–4** form cluster ions $[M + NH_4]^+$ by CI(NH_3). The MIKE and CA spectra of these ions are shown in Table 2. The only reactions observed in the MIKE spectra are the sequential losses of NH_3 and CH_3OH to yield the ions *m/z* 323 and 291 (Scheme 2). The relative abundances of these ions are almost identical for the isomers **1–4**. The CA spectra of the $[M + NH_4]^+$ adducts of **1–4** exhibit additional peaks, reflecting further fragmentation of the glycosidyl cations (*m/z* 291) by losses of CH_3COOH and CH_2CO. However, although the intermediate ions, *m/z* 291, correspond at least formally to the glycosidyl cations a_1 generated by EI from **1–4** (see Table 1), the CA spectra of the cluster ions do not show the characteristic differences observed in the CA spectra of these ions.



Scheme 2

V. K. thanks the Alexander v. Humboldt-Stiftung for a stipendium as a visiting scientist. The financial assistance of this work by the Deutsche Forschungsgemeinschaft is gratefully acknowledged.

Yours

V. KOVÁČIK (to whom correspondence should be addressed)
Institute of Chemistry, Slovak Academy of Sciences,
Dúbravská cesta, 84238 Bratislava, ČSFR.

P. KOVÁČ
NIDKK, National Institute of Health, Bethesda,
MD 20892, U.S.A.

H.-Fr. GRÜTZMACHER
Fakultät für Chemie, Universität Bielefeld,
Universitätsstraße, D-4800 Bielefeld, Germany.

References

1. (a) P. Kováč, H. J. C. Yeh and C. P. J. Glaudemans, *Carbohydr. Res.* **169**, 23 (1987); (b) P. J. Card, *J. Org. Chem.* **48**, 393 (1983).
2. K. Biemann, D. C. DeJongh and K. H. Schnoes, *J. Am. Chem. Soc.* **85**, 1763 (1963).
3. V. Kováčik, E. Petráková, V. Mihálov, I. Tvaroška and W. Heerma, *Biomed. Mass Spectrom.* **12**, 49 (1985).
4. V. Kováčik, V. Mihálov and P. Kováč, *Carbohydr. Res.* **54**, 23 (1977).
5. K. Heyns, H.-Fr. Grützmacher, H. Scharmann and D. Müller, *Fortschr. Chem. Forsch.* **13**, 448 (1966).
6. V. Kováčik and H.-Fr. Grützmacher, *Org. Mass Spectrom.* **25**, 687 (1990).