MASS SPECTRA OF ERGOT PEPTIDE ALKALOIDS

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Mass spectra of ergot peptide alkaloids characterize the peptide part of the molecule. Its ionic fragments represent 80–90% of the total ion current. Ion *c* corresponding to the complete peptide group decomposes in an ionic sequence which is influenced by the substitution in the $C_{(5')}$ position.

In the previous communication[1] we dealt with a rapid identification of ergot alkaloids from the characteristic peaks in their mass spectra. In the case of ergot nonpeptide alkaloids this way of identification is based on two detailed mass spectrometric studies[2,3]. In this communication we turn our attention to the fragmentation of ergot-peptide alkaloids on which there is little information in the literature[2].

EXPERIMENTAL

The mass spectra were measured using a Varian MAT 311 mass spectrometer. The ionizing electron energy was 70 eV and the electron current 1 mA; the temperature of the ion source was 160–200°C, the temperature of the direct inlet system was 150–190°C.

RESULTS AND DISCUSSION

The mass spectra of ergot peptide alkaloids (Fig. 1–2) of the general formula *I* are characteristic of the peptide part of the molecule. The molecular ion *a* is absent in the mass spectra obtained by 70 eV electron impact ionization. Ions *b* and *c* originate from it by splitting of the bond between the $C_{(8)}$ carboxamidic nitrogen and the quaternary carbon $C_{(2')}$, and by the hydrogen atom transfer from the peptidic part to the (iso)lysergamidic part. Ion *b*(*m*/*e* 267) is identical with the molecular ion of ergine (erginine) whose fragmentation is known[3]. This ion and its fragments form 10–20% of the total ion current. The substantial part of the ion current, however, comes from the ions of the peptidic part of the molecule (80–90%). Ion *c* – for which two structures are suggested here – corresponds to the complete peptide part of the molecule. It is useful to distinguish, according to the substitution in the 5'position, between the ergot peptide alkaloids with the $C_{(5')}$ benzyl group, and those

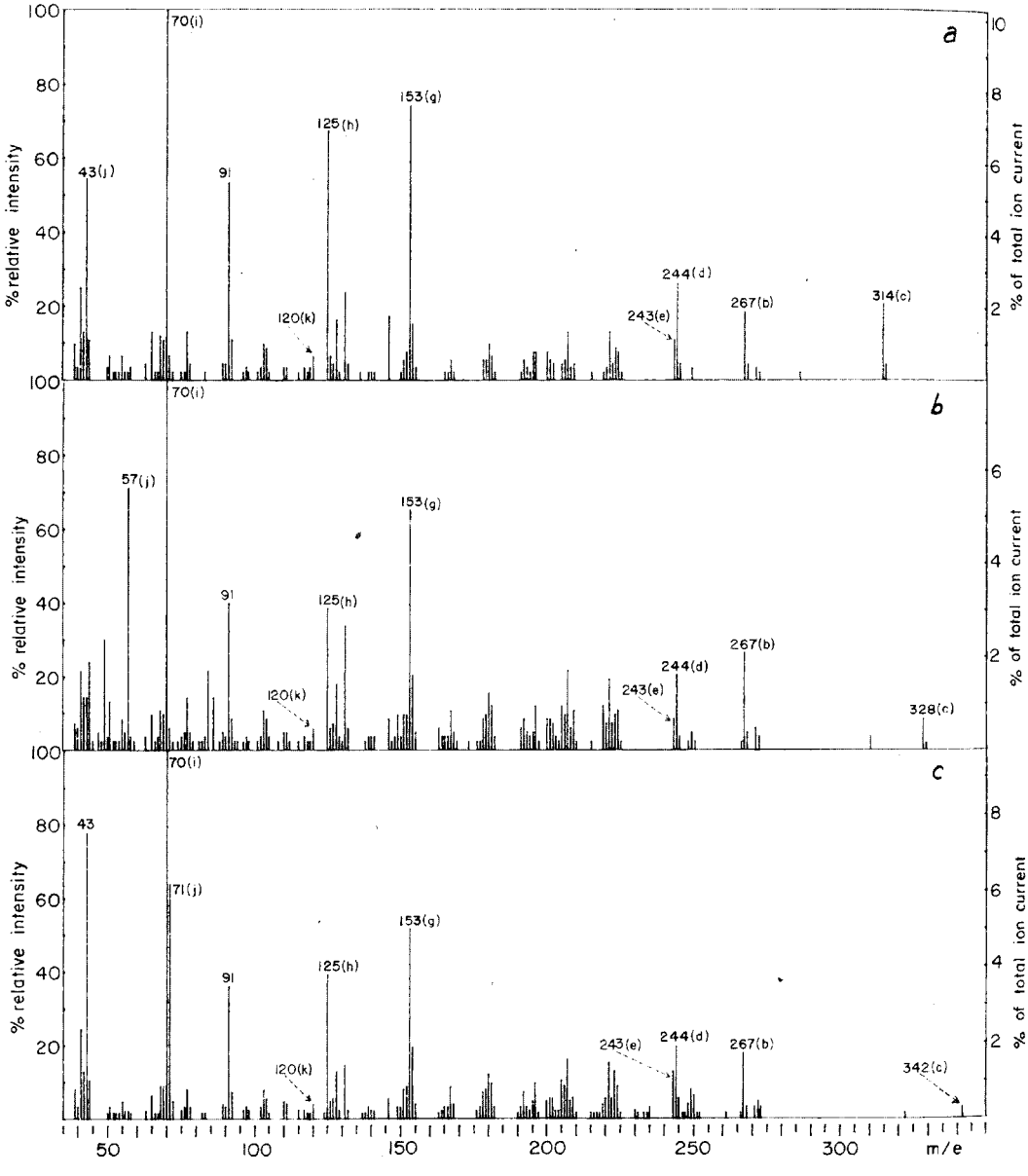


FIG. 1

Low Resolution Mass Spectra of Ergot Peptide Alkaloids Ergotamine (*a*), Ergostinine (*b*) and Ergocristinine (*c*)

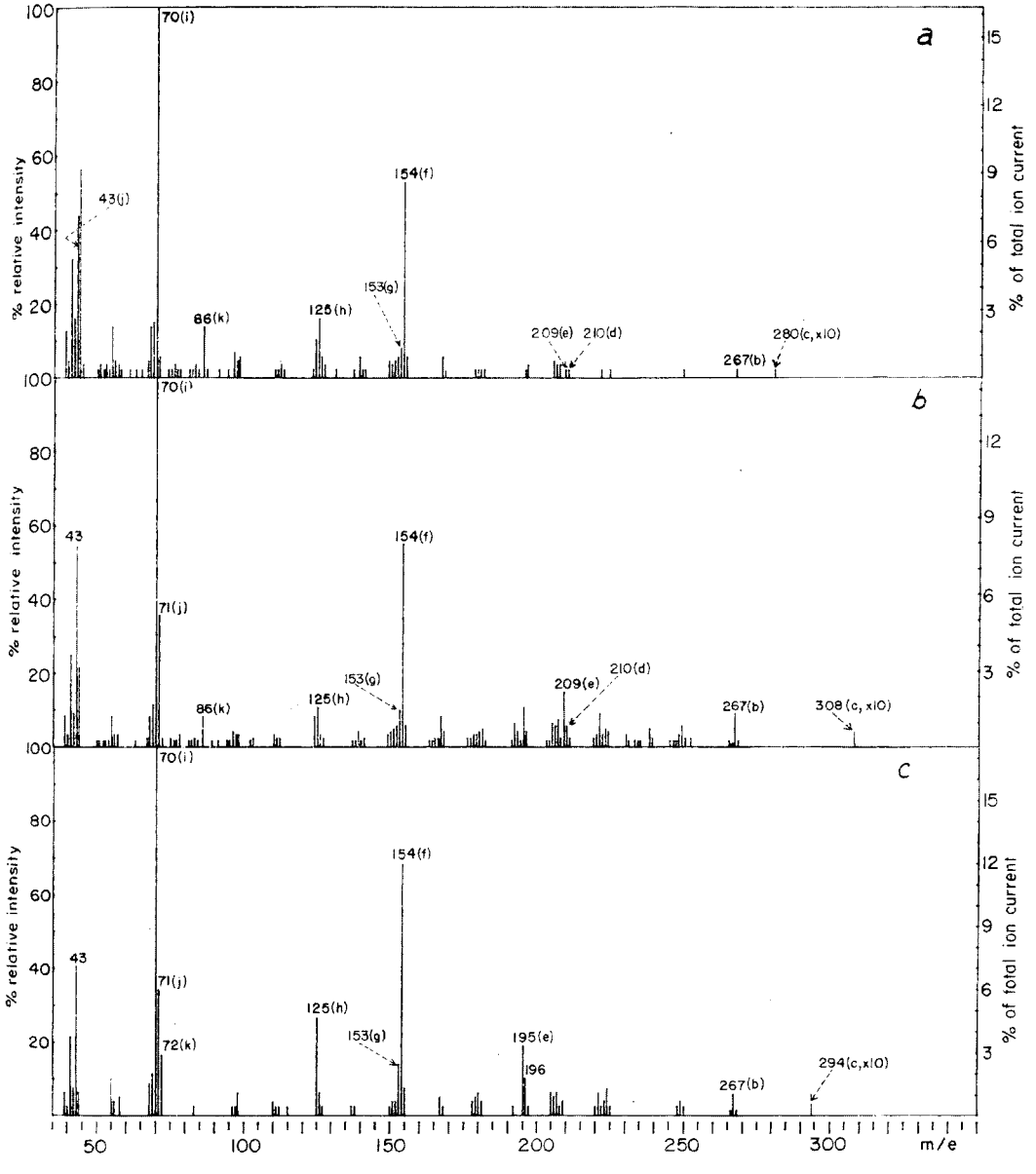
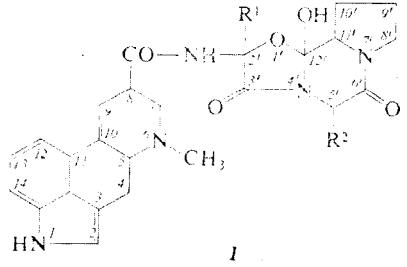


FIG. 2

Low Resolution Mass Spectra of Ergot Peptide Alkaloids Ergosine (*a*), Ergocryptine (*b*) and Ergocornine (*c*)

with the $C_{(5')}$ isoalkyl group. The relative abundance of ion *c* is by an order of magnitude higher with the substances with the $C_{(5')}$ benzyl group than with those with the $C_{(5')}$ isoalkyl group. Ion $f(m/e\ 154)$ is present only in the spectra of substances with the $C_{(5')}$ isoalkyl group and forms more than 50% of the base peak. By the elimination of ketene and carbon monoxide from ion *c* ion *d* is formed which is identical with the molecular ion of the 2,5-piperazindion derivatives (cyclodipeptides)



I

Ergotamine: $R^1 = CH_3$, $R^2 = C_6H_5CH_2$
Ergostinine: $R^1 = C_2H_5$, $R^2 = C_6H_5CH_2$
Ergocristinine: $R^1 = (CH_3)_2CH$, $R^2 = C_6H_5CH_2$

Ergosine: $R^1 = CH_3$, $R^2 = (CH_3)_2CHCH_2$
Ergocryptine: $R^1 = (CH_3)_2CH$, $R^2 = (CH_3)_2CHCH_2$
Ergocornine: $R^1 = R^2 = (CH_3)_2CH$

and decomposes to the same fragments[4,5]. In the case of ergotamine, ergostinine, and ergocristinine (R^2 = benzyl) a stable benzyl (tropylium) radical is split off from ion *d* and ion $g(m/e\ 153)$ is formed. In the case of ergosine and ergocryptine (R^2 = isobutyl) isobutene is eliminated more easily from ion $d = d'(m/e\ 210)$ and ion $f(m/e\ 154)$ is formed. In the case of ergocornine ion *d* was not confirmed by the high-resolution measurement, but it follows from the metastable scans (DADI –

TABLE I

Diagnostic Peaks in the Mass Spectra of Measured Ergot Peptide Alkaloids

Alkaloid	*c*	*j*	*k*	Alkaloid	*c*	*j*	*k*
Ergotamine	314	43	120	Ergosine	280	43	86
Ergostinine	328	57	120	Ergocryptine	308	71	86
Ergocristinine	342	71	120	Ergocornine	294	71	72

direct analysis of daughter ions; AVS – acceleration voltage scan) that ion *c* is the precursor of ion *f*. Ions *e* and *g*(*m*/*e* 153) whose 4′–5′ double bond is a part of the conjugated system occur in all ergot peptide alkaloids we studied. The relative abundance of ion *g* in the $C_{(5')}$ benzyl group substances is by half-an-order of magnitude higher than in the $C_{(5')}$ isoalkyl substances. Ion *g* was not found in the cyclodipeptide *c* (Pro-Leu) (ref.[5]). Ions *f* and *g* are precursors of ion *h*(*m*/*e* 125) which originated by the loss of CHO or CO. A further loss of CO and HCN transforms ion *h* to ion *i*(*m*/*e* 70) which represents the base peak of the spectrum at 70 eV electron energy.

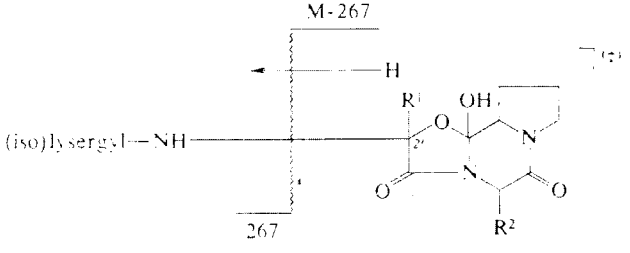
The fragmentation of ion *c* was studied by the DADI technique, and the following sequences were found, depending of the substituent R^2:

R^2 = benzyl (ergotamine, ergostinine, ergocristinine)

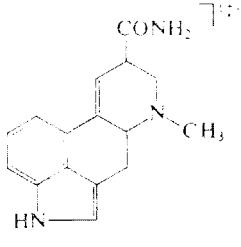
$$c \rightarrow d \rightarrow g(m/e\ 153) \rightarrow h(m/e\ 125) \rightarrow i(m/e\ 70)$$

R^2 = isobutyl (ergosine, ergocryptine)

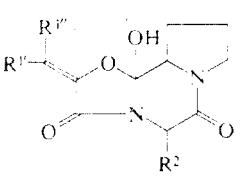
$$c \rightarrow d \rightarrow f(m/e\ 154) \rightarrow h(m/e\ 125) \rightarrow i(m/e\ 70)$$
$$g(m/e\ 153) \rightarrow h(m/e\ 125) \rightarrow i(m/e\ 70)$$



a

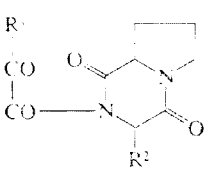


b, *m*/*e* 267

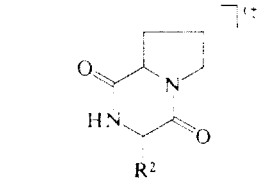


R^{IV}, R^{IV} = H, CH_3

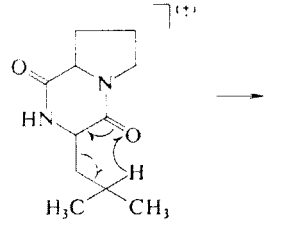
or



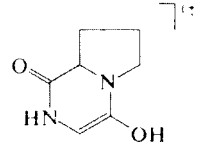
c



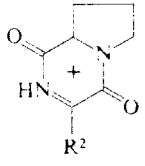
d



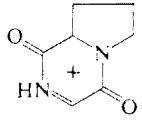
d', m/e 210



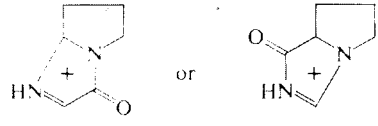
f, m/e 154



e

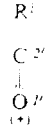


g, m/e 153

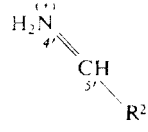


h, m/e 125

i, m/e 70



j



k

R^2 = isopropyl (ergocornine)

$$c \rightarrow f(m/e\ 154) \rightarrow h(m/e\ 125) \rightarrow i(m/e\ 70)$$

$$g(m/e\ 153) \rightarrow h(m/e\ 125) \rightarrow i(m/e\ 70)$$

Ions *j* and *k* originate from the peptide part of the molecule. They contain the substitutents R^1 and R^2 by which the ergot peptide alkaloids differ and thus they are, together with ion *c*, of diagnostic importance. The precursors of ions *j* and *k* could not be experimentally confirmed from the metastable scans (DADI, AVS). The substances with the $C_{(5')}$ benzyl group render benzyl (tropylium) ion together with ion *k*. The elemental composition of the above discussed ions was confirmed by the high-resolution measurement.

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