MASS SPECTRA OF METHOXY-SUBSTITUTED 4-AMINOPYRIMIDINES

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In a study of the mass spectra of methoxy-substituted 4-aminopyrimidines it has been shown that in the molecular ion the positive charge is predominantly concentrated on the oxygen atom of the methoxy group, which explains the appearance of the fragmentary ions $(M-H)^+$ and $(M-CH_2O)^+$. In contrast to the halopyrimidines, the molecular ion does not exist in the imine form, which is characteristic only for the fragmentary ions $(M-CH_2O)^+$.

An investigation that we have performed of simple pyrimidine systems under the action of electron impact [1, 2] revealed the influence of halogens and of various functional groups on the isomerization of the molecular ion and its behavior in the first stages of decomposition.

In the present paper, we consider the mass spectra of the following methoxy-substituted 4-aminopyrimidines: 4-amino-2-methoxy-6-methylpyrimidine , 4-amino-6-methoxy-2-methylpyrimidine (II), 4-amino-2-methoxy-5-methylpyrimidine (III), 4-amino-2,6-dimethoxypyrimidine (IV), and 4-amino-6-chloro-2-methoxypyrimidine (V) (Table 1).

The mass spectra were obtained on a Varian MAT-CH-6 instrument with the direct introduction of the substance into the ion source at a temperature of the ionization chamber of 180°C and ionizing voltages of 70 and 20 V.

Table 2 gives the values of the stabilities of the molecules to electron impact (W_M) as the ratios of the intensities of the polyisotopic peak of the molecular ion to the total current in percentages, and the values of the selectivity of decomposition ($S_{1/2}$), consisting of the number of the most intense peaks in the mass spectrum amounting to half the total ion current, and the intensities of some characteristic peaks of the ions.

The values of W_M for the compounds investigated are far lower, not only than for the corresponding 4-amino(methyl)pyrimidines but also than for the analogous 4-amino(halo)pyrimidines [2], which, together with the absence from the mass spectra of compounds (I-V) of peaks of the ions $(M-HCN)^+$ and $(M-CH_3CN)^+$ shows* the predominant localization of the charge in the molecular ion on the oxygen atom and the fact that the methoxy group determines the mechanism of decomposition of these compounds.

It follows from a consideration of the mass spectra that the imine form of the molecular ion, which is predominant in the case of halogen-substituted 4-aminopyrimidines [2] is not formed in the dissociative ionization of methoxy-substituted aminopyrimidines if they do not contain halogen as a second substituent.

It is known that in the decomposition of methoxy-substituted aromatic compounds under electron impact [3], ions arising through the cleavage of one of the two $Ar-O-CH_3$ bonds are formed with high probability. However, in the mass spectra of compounds (I-V), the peak of the ion $(M-CH_3)^+$ is practically absent. In the first stage, two processes are predominant: the splitting off of a hydrogen atom and the elimination

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*Here and below, M is the mass of the molecular ion.

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TABLE 1. Mass Spectra of the Compounds Investigated (I-V) (the peaks with intensities greater than 3% of the maximum peak are given)

4-Amino-2-methoxy-6-methylpyrimidine

26 (3,3), 27 (7,6), 29 (3,6), 30 (4,2), 38 (4,8), 39 (10,6), 40 (25,8), 41 (45,5), 42 (47,0), 43 (9,1), 52 (3,6), 53 (4,8), 54 (9,1), 55 (9,1), 56 (9,1), 58 (4,2), 66 (12,1), 67 (5,2), 68 (100,0), 69 (10,6), 70 (3,9), 82 (6,1), 103 (5,5), 109 (16,7), 110 (12,1), 116 (5,8), 138 (81,8), 139 (62,1), 140 (6,0)

4-Amino-6-methoxy-2-methylpyrimidine

27 (6,9), 29 (4,6), 30 (3,2), 40 (5,5), 41 (19,6), 42 (49,4), 43 (37,4), 45 (4,2), 54 (3,5), 55 (6,1), 56 (8,6), 57 (8,0), 66 (7,5), 67 (21,0), 68 (100,0), 69 (14,4), 70 (3,9), 82 (6,1), 109 (18,2), 110 (12,4), 138 (15,2), 139 (75,8), 140 (6,6)

4-Amino-2-methoxy-5-methylpyrimidine

26 (4,4), 27 (8,7), 29 (6,3), 38 (6,5), 39 (22,0), 40 (15,7), 41 (27,5), 42 (26,4), 43 (23,1), 52 (9,4), 53 (6,6), 54 (18,2), 55 (13,7), 56 (4,6), 58 (12,8), 65 (4,6), 66 (20,9), 67 (35,2), 68 (12,9), 69 (48,4), 70 (3,7), 81 (5,8), 82 (54,9), 83 (7,8), 92 (5,7), 93 (5,8), 94 (13,0), 97 (3,8), 108 (13,6), 109 (100,0), 110 (18,8), 116 (4,9), 138 (44,0), 139 (96,7), 140 (7,9)

4-Amino-2,6-dimethoxypyrimidine

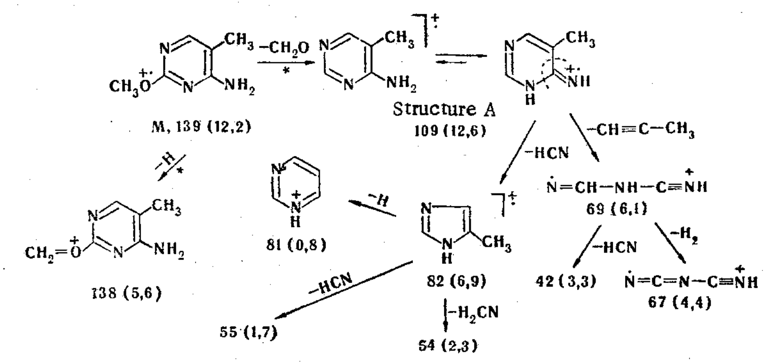
26 (13,2), 27 (45,9), 29 (41,0), 30 (20,6), 31 (25,9), 38 (13,2), 39 (19,0), 40 (41,0), 41 (55,7), 42 (36,1), 43 (44,3), 45 (3,7), 50 (5,3), 51 (4,8), 52 (4,8), 53 (10,6), 54 (11,1), 55 (23,8), 56 (13,2), 57 (24,3), 58 (24,3), 66 (29,6), 67 (15,9), 68 (45,9), 69 (24,9), 70 (16,9), 71 (7,9), 80 (3,7), 81 (15,8), 82 (14,9), 83 (10,6), 84 (13,2), 85 (7,4), 93 (7,4), 94 (6,9), 95 (14,3), 96 (9,5), 97 (11,6), 98 (6,9), 109 (12,7), 110 (45,9), 111 (12,7), 112 (4,8), 125 (49,2), 126 (20,6), 127 (5,3), 153 (11,6), 154 (96,7), 155 (100,0), 156 (8,9)

4-Amino-6-chloro-2-methoxypyrimidine

27 (12,8), 29 (11,5), 30 (15,7), 31 (5,1), 38 (8,1), 39 (17,9), 40 (12,8), 41 (11,1), 42 (18,3), 43 (76,5), 47 (4,3), 51 (8,1), 52 (14,0), 53 (11,9), 54 (6,8), 55 (9,4), 56 (5,5), 57 (22,5), 58 (4,7), 60 (4,3), 62 (6,8), 64 (4,3), 65 (7,7), 66 (14,0), 67 (45,1), 68 (13,2), 69 (8,5), 74 (8,4), 76 (7,2), 82 (23,8), 86 (5,1), 87 (12,3), 88 (5,5), 89 (6,8), 92 (11,9), 93 (5,1), 94 (29,8), 95 (3,4), 102 (9,4), 104 (5,1), 116 (6,8), 123 (5,1), 124 (21,7), 125 (4,3), 128 (6,8), 129 (36,6), 130 (32,7), 131 (17,4), 132 (11,1), 142 (3,8), 143 (4,3), 154 (4,3), 155 (4,7), 158 (65,5), 159 (100,0), 160 (29,3), 161 (31,5)

of a neutral fragment with the structure of formaldehyde. The probability of the latter process rises by a factor of ~2 with a reduction in the energy of the ionizing electrons to 20 eV.

The elimination of hydrogen in the reaction of ionizing electrons with compounds (I-III) can take place both from the methyl group and from the methoxy group. In favor of the first direction is the considerable mobility of the hydrogen atoms of methyl groups in positions 2, 4, and 6 of the pyrimidine ring, and also the general tendency for the detachment of a hydrogen atom from the β position with respect to an aromatic nucleus on electron impact. However, the high intensity of the ion $(M-H)^+$ in the mass spectra of compounds (IV) and (V) containing no methyl substituents shows that, at least, the bulk of the ions $(M-H)^+$ is formed by the detachment of a hydrogen atom from the methoxy group.



The ejection of a formaldehyde particle is connected with the formation of a stable pseudomolecular ion $(M-CH_2O)^+$ of mass 109, which has the structure of a 4-amino(methyl)pyrimidine (structure A). This ion probably exists predominantly in the imine form [2]. The elimination of a neutral fragment HCN from the ion $(M-CH_2O)^+$ leads to the formation of another pseudomolecular ion with mass 82 and the structure of a methylimidazole.

A characteristic feature for compound (III) is the opening of the pyrimidine ring on the elimination of a molecule of methylacetylene from the ion with structure A. In the case of compound (II) the ejection of a

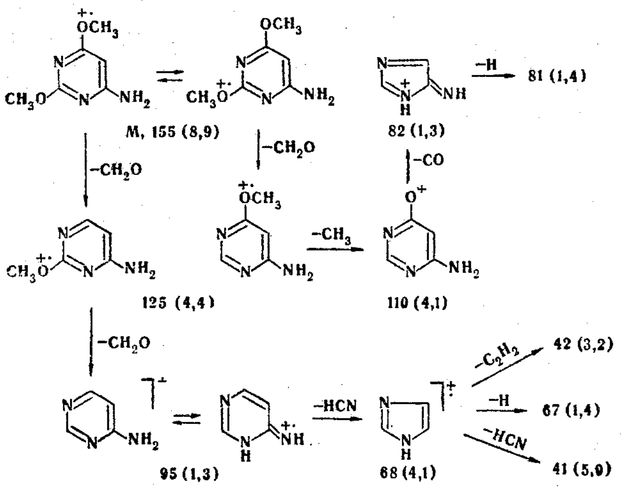
TABLE 2. Stability of the Molecules to Electron Impact (W_M), Selectivity of Decomposition ($S_{1/2}$), and Intensities of the Characteristic Ions in the Mass Spectra of Methoxy-Substituted Pyrimidines (intensities of the peaks given in % of the total ion current)

Ions	Compounds				
	I	II	III	IV	V
W_M	10,0	14,7	12,2	8,9	12,6
$S_{1/2}$	6,0	6,0	9,0	11,0	7,0
$(M-H)^+$	13,2	3,1	5,6	8,6	10,2
$(M-CH_2O)^+$ (structure A)	2.7	3,5	12,6	4,4	4,9
$(A-HCN)^+$	1,0	1,2	6,9	—	1,2
$(A-CH_3C_2H)^+$	1,7	1,5	6,1	—	—
$(A-CH_3CN)^+$	16,2	19,5	1,6	—	—
$(A-CH_3)^+$	—	—	—	4,1	—
$(A-CH_2O)^+$	—	—	—	1,3	—
$(M-HCN)^+$	—	—	—	—	1,3
$(M-Cl)^+$	—	—	—	—	2,4
$(M-H)^+/(M-CH_2O)^+$	4,9	0,9	0,4	2,0	2,0

molecule of acetonitrile from the same ion takes place with high probability, which leads to the appearance of an ion with mass 68 corresponding to the maximum peak in the spectrum of this compound.

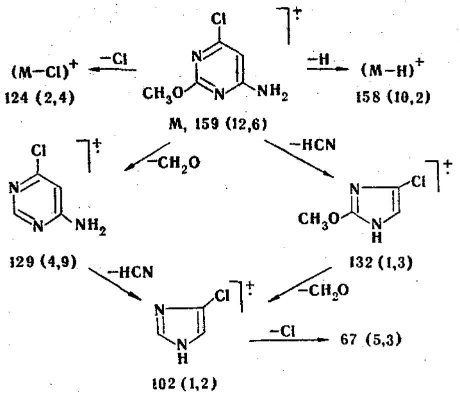
The dissociative ionization of compound (IV), which has two methoxy groups in the pyrimidine nucleus, differs little in principle from the decomposition of compounds (I-III). Obviously, in this case one must consider the equiprobability of the localization of the charge on the two oxygen atoms.

Like the decomposition of the molecule of m-dimethoxybenzene [3], for compound (IV) the successive splitting off from the molecular ion of two formaldehyde molecules is characteristic. As a result of this process, fragmentary ions arise with masses of 125 and 95 which have the structures of a 4-amino(methoxy)pyrimidine and of unsubstituted 4-aminopyrimidine, respectively. The appearance of a pseudomolecular ion with mass 125 is accompanied by the formation of an additional decomposition pathway connected with cleavage of the C—O bond that is characteristic for methoxy compounds. The cleavage of this bond leads to the detachment of a methyl group from the methoxy substituent with the formation of an ion having mass 110. The subsequent elimination of carbon monoxide leads to the formation of a stable fragmentary ion with mass 82.



The introduction of a chlorine atom into the nucleus of the molecule of (V) is responsible for the appearance of a new field of localization of the charge in the molecular ion, which leads to the formation of the ions $(M-Cl)^+$. In addition, yet another competing direction arises which is connected with the localization of the charge on the nitrogen atom of the amino group, as is confirmed by the presence in the spectrum of compound (V) of the peak of the fragmentary ion $(M-HCN)^+$.

The intensities of the characteristic peaks of the ions given in Table 2 permit each of the compounds under consideration to be clearly identified. Thus, in the case of the isomeric compounds (I-III) the structure of each compound is easily established from the ratio of the peaks of the ions $(M-H)^+$ and $(M-CH_2O)^+$. The ejection of a particle of acetonitrile from the ion with structure A is characteristic only for compounds (I) and (II), while the elimination of a particle of methylacetylene takes place with greater probability in the case of compounds (III).



Compounds (IV) and (V) differ sharply both from the analogs (I)-(III) and from one another with respect to the peaks of the ions $(M-HCN)^+$ and $(M-Cl)^+$.

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