

Mass Spectral Studies of 6,8-Disubstituted-3-(3',5'-disubstituted-, 3',4'-disubstituted phenylmethyl-, ethenyl)isocoumarins

NASIM H. RAMA*, RASHID IQBAL, KHOSROW ZAMANI, AAMER SAEED AND MUHAMMAD T. HUSSAIN

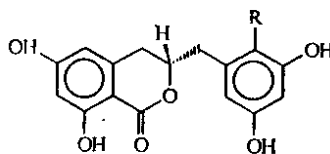
Department of Chemistry, Quaid-i-Azam University Islamabad-45320 Pakistan

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Summary: Mass spectra of 6,8-dihydroxy-3-(3',5'-dihydroxyphenylmethyl-, 3',4'-dihydroxyphenylethenyl) isocoumarins (2b & 3b) and their methylether derivatives (2a & 3a) are discussed. The mass fragmentation patterns were derived with the help of LREIMS, HREIMS, and link scan measurements.

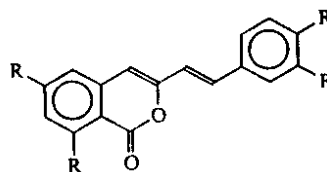
Introduction

In 1993, Speranza *et al.* [1] isolated a new dihydroisocoumarin from the commercial sample of *Cape aloe*, which they named as *feralolide* (1a, R=Ac). Commercial *Cape aloe* is the dried exudate of *Aloe ferox* Miller, (Liliaceae). Aloe is a drug well known for its cathartic properties and also as a bittering agent in alcoholic beverages. The structure of feralolide was established by FTIR, various techniques of PMR (COLOC, NOE experiments etc.), CMR, ^{13}C -H COSY, FAB and HREIMS as (3R)-3,4-dihydro-6,8-dihydroxy-3-(2'-acetyl-3',5'-dihydroxyphenylmethyl)isocoumarin. In 1990 Mizuno and Yoshida *et al.* [2] carried out a chemical investigation of the plant *Achlys triphylla* DC (Berberidaceae), to determine its chemotaxonomic relationships with other members of the subtribe Epimedinae and to look for compounds of medicinal importance. The isolation of three new phenolic compounds was established by them using IR, UV, PMR, CMR and high resolution mass spectra. These were named as achlisocoumarin I, achlisocoumarin II and achlisocoumarin III (3a). We have reported [3,4] simple two steps synthesis of 6,8-dihydroxy-3-(3',5'-dihydroxyphenylmethyl)isocoumarin (2b) related to deacetylferalolide (1b) and 6,8-dihydroxy-3-(3',4'-dihydroxyphenylethenyl)isocoumarin (3b) which is a demethylated derivative of achlisocoumarin III along with their methylether derivatives (2a, 3a). In this article we wish to report LREIMS studies of compounds (2a-b & 3a-b), which would provide a reference mass spectral library to these class of compounds.



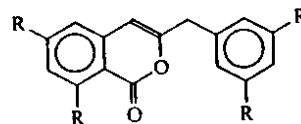
1a) R=COCH₃,

1b) R=H



2a) R=OCH₃,

2b) R=OH

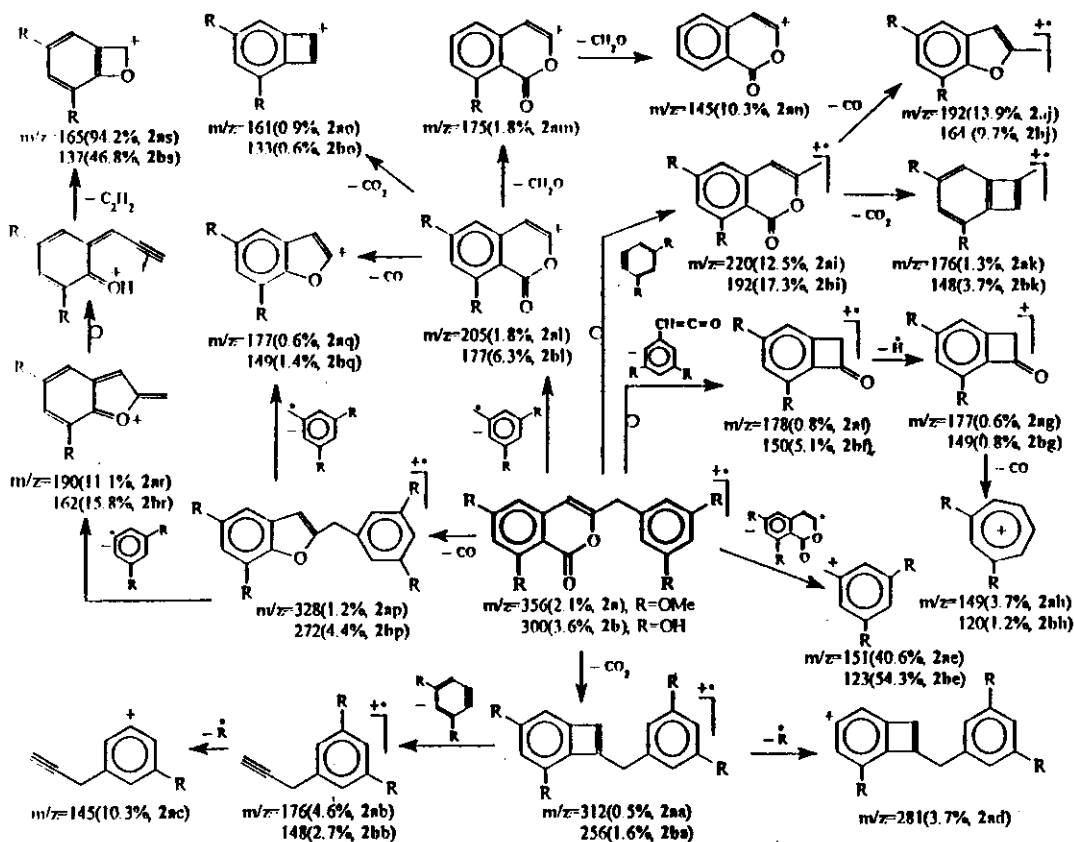


3a) R=OCH₃,

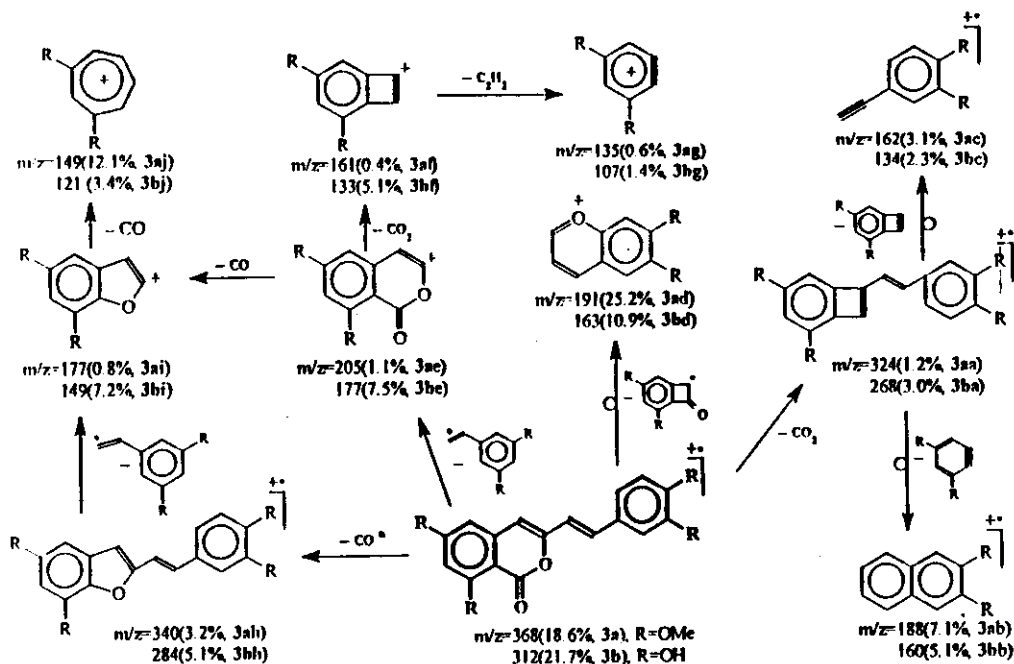
3b) R=OH

Results and Discussion

The general fragmentation patterns of compounds (2a-b & 3a-b) are illustrated with the help of LREIMS and link scan measurements and are depicted in Schemes (1 & 2).



(Scheme-1)



(Scheme-2)

6,8-Disubstituted-3-(3',5'-disubstitutedphenylmethyl) isocoumarins (2a & 2b):

The molecular ion peaks of compounds (2a & 2b) appeared at m/z 356 ($C_{20}H_{20}O_6$, 2a) and 300 ($C_{16}H_{12}O_6$, 2b) respectively. The loss of CO_2 molecule from respective molecular ions furnished radical cations at m/z 312 ($C_9H_{20}O_4$, 2aa) and 256 ($C_{15}H_{12}O_4$, 2ba) followed by the loss of substituted benzyne to yield radical cations at m/z 176 ($C_8H_8O_2$, 2ab) and 148 ($C_6H_4O_2$, 2bb). The removal of methoxy radical from (2ab & 2aa) yielded cations at m/z 145 ($C_{10}H_9O$, 2ac) and 281 ($C_{18}H_{17}O_3$, 2ad). Elimination of substituted isocoumarin radical from the molecular ions afforded cations at m/z 151 ($C_9H_{11}O_2$, 2ae) and 123 ($C_7H_7O_2$, 2be). The removal of a ketene moiety from the molecular ions (2a-b) yielded cyclic ketone radical cations at m/z 178 ($C_{10}H_{10}O_3$, 2af) and 150 ($C_8H_6O_3$, 2bf) followed by the removal of hydrogen radical affording cations at m/z 177 ($C_{10}H_9O_3$, 2ag) and 149 ($C_8H_5O_3$, 2bg). Further loss of CO molecule from (2ag-bg) afforded tropillium cations at m/z 149 ($C_9H_9O_2$, 2ah) and 120 ($C_7H_5O_2$, 2bh) respectively. The direct loss of the substituted benzyne moiety from molecular ions afforded 6,8-disubstituted-3-methylisocoumarin radical cations at m/z 220 ($C_{12}H_{12}O_4$, 2ai) and 192 ($C_{10}H_8O_4$, 2bi). The loss of CO_2 and CO molecules from (2ai-bi) yielded radical cations at m/z 176 ($C_{11}H_{12}O_2$, 2ak), 148 ($C_9H_8O_2$, 2bk), 192 ($C_{11}H_{12}O_3$, 2aj) and 164 ($C_9H_8O_3$, 2bj) respectively. The removal of 3,5-disubstituted benzyl radical from (2a-b) yielded isocoumarin cations at m/z 205 ($C_{11}H_9O_4$, 2al) and 177 ($C_9H_5O_4$, 2bl) followed by the elimination of CO_2 and CO molecules generating cations at m/z 161 ($C_{10}H_9O_2$, 2ao), 133 ($C_8H_5O_2$, 2bo) and 177 ($C_{10}H_9O_3$, 2aq), 149 ($C_8H_5O_3$, 2bq). Two successive losses of CH_2O molecules from (2al) afforded isocoumarin cations at m/z 175 ($C_{10}H_7O_3$, 2am) and 145 ($C_9H_7O_2$, 2an) respectively. The loss of CO molecule from molecular ions afforded radical cations at m/z 328 ($C_{19}H_{20}O_5$, 2ap) and 272 ($C_{15}H_{12}O_5$, 2bp) followed by elimination of substituted phenyl radical to afford substituted five membered ring of 2-methylene-5,7-disubstituted-1-benzoxole cations at m/z 190 ($C_{11}H_{10}O_3$, 2ar) and 162 ($C_9H_6O_3$, 2br). Rearrangement and then loss of C_2H_2 from these cations gave peaks at m/z 165 ($C_9H_9O_3$, 2as) and 137 ($C_7H_5O_3$, 2bs). Removal of

substituted benzyl radical from (2ap-bp) afforded cation (2aq-bq) (Scheme-1).

6,8-Disubstituted-3-(3',4'-disubstituted phenylethenyl)isocoumarins (3a-b):

The EIMS of compounds (3a-b) exhibited radical cations at m/z 368 ($C_{21}H_{20}O_6$, 3a) and 312 ($C_{17}H_{12}O_6$, 3b). Elimination of CO_2 molecule from the molecular ions (3a-b) yielded radical cations at m/z 324 ($C_{20}H_{20}O_4$, 3aa) and 268 ($C_{16}H_{12}O_4$, 3ba). Further elimination of a bicyclic alkene yielded substituted alkynes at m/z 162 ($C_{10}H_{10}O_2$, 3ac) and 134 ($C_8H_6O_2$, 3bc). On the other hand removal of substituted benzyne afforded radical cations at m/z 188 ($C_{12}H_{12}O_2$, 3ab) and 160 ($C_{10}H_8O_2$, 3bb). The loss of cyclic ketone radical from (3a-b) afforded cations at m/z 191 ($C_{11}H_{11}O_3$, 3ad) and 163 ($C_9H_7O_3$, 3bd). The direct loss of substituted alkene radical from molecular ion yielded 6,8-disubstituted isocoumarin cations at m/z 205 ($C_{11}H_9O_4$, 3ae) and 177 ($C_9H_5O_4$, 3be) followed by elimination of CO_2 molecule affording cations at m/z 161 ($C_{10}H_9O_2$, 3af) and 133 ($C_8H_5O_2$, 3bf). The removal of acetylene molecule from the latter furnished substituted benzyne cations at m/z 135 ($C_8H_7O_2$, 3ag) and 107 ($C_6H_3O_2$, 3bg). The loss of CO molecule from (3ae-be) yielded cations at m/z 177 ($C_{10}H_9O_3$, 3ai) and 149 ($C_8H_5O_3$, 3bi) followed by the elimination of another CO molecule to form tropillium cations at m/z 149 ($C_9H_9O_2$, 3aj) and 121 ($C_7H_5O_2$, 3bj). Loss of CO molecule from (3a-b) afforded radical cations at m/z 340 ($C_{20}H_{20}O_5$, 3ah) and 284 ($C_{16}H_{12}O_5$, 3bh) followed by the loss of substituted alkene radical to generate cations (3ai-bi) (scheme-2).

Experimental

Compounds (2a-b and 3a-b) were prepared according to literature procedure [3,4]. These compounds were characterised by IR, MS and 1H -NMR spectral data. The EIMS were recorded on MAT-311 instrument with an accelerating voltage of 3 kV and ionization energy of 70 eV. The temperature of the ion source was maintained at 250°C and inlet temperature was 110°C.

References

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3. A. Saeed, and N. H. Rama; *J. Chem. Soc. Pak.*, **16**, 220 (1994).
4. A. Saeed, and N. H. Rama; *The Arabian Journal for Science and Engineering*, **21**, 403 (1996).