Tetrahedron Letters,Vol.26,No.36,pp 4349-4350,1985 0040-4039/85 $3.00 + .00
Printed in Great Britain

[(METHOXYTHIO)CARBONYL]PYRIDINE DERIVATIVES A NEW CLASS OF SULFUR COMPOUNDS[1]

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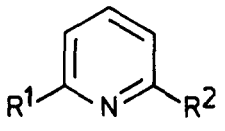
Abstract: From the culture medium of *Pseudomonas* species pyridine derivatives were isolated which contain the (methoxythio)carbonyl (-CO-S-OCH_3) group thus far not described in literature.

From the culture medium of *Pseudomonas putida* and of two related species[2] after treatment with CH_2N_2 pyridine derivatives have been isolated which contain the -CO-$SOCH_3$ - group (the monothio analog of a peracid ester) thus far not described in the literature, *viz.* 6-[(methoxythio)carbonyl]pyridine-2-monothiocarboxylic acid S-methyl ester (1), 6-[(methoxythio)carbonyl]pyridine-2-carboxylic acid methyl ester (2), and 2,6-di[(methoxythio)carbonyl]pyridine (3). 1 has an elemental composition (by exact mass measurement) of $C_9H_9NO_3S_2$. The fragmentation pattern very much resembles that of pyridine-2,6-di(monothiocarboxylic acid) di-S-methyl ester[3] (4); in contrast to 4, however, $[M - {}^{\cdot}SOCH_3]^+$ (*m/z* 180) and $[M - {}^{\cdot}COSOCH_3]^+$ (*m/z* 152) (instead of $[M - {}^{\cdot}SCH_3]^+$ and $[M - {}^{\cdot}COSCH_3]^+$ is observed. Below *m/z* 152 the mass spectra of 1 and 4 - except for slight differences in the relative intensities - are identical. This demonstrates the presence of a $COSCH_3$ group in 2-position (loss of the C-6 substituent from 1 as well as from 4 leads to ions of identical structure which fragment by very characteristic rearrangement processes of the remaining $COSCH_3$ group;[3] see also below).

The ^{1}H-NMR spectrum (CD_2Cl_2) exhibits between 7.99 and 8.20 ppm a 3 H pattern typical for pyridine derivatives 2,6-disubstituted with non-identical groups,[4] and 3 H singlets at 2.46 ($COSCH_3$) and 3.87 ppm (OCH_3) which excludes a methyl sulfoxide (CH_3-$\overset{\downarrow}{S}$=O) structure requiring a methyl signal between 2.6 and 2.8 ppm.[5] The presence of a thiocarbonyl group can be excluded by the UV spectrum ($\lambda_{max.}$ 286 nm, 20% hexane in $CHCl_3$) as C=S is manifested by an absorption at $\sim$ 420 nm,[3,6] while the presence of a second carbonyl band at 1696 cm^{-1} (in addition to one at 1675 cm^{-1} characteristic[3] for the $COSCH_3$ group) suggests for the second functional group a thioester-like structure. The presence of an S-O-C unit is finally corroborated by strong IR absorptions[7] at 984 and 913 cm^{-1} accompanied by a less intense pair at 741 and 729 cm^{-1}.

2 and 3 which accompany 1 only in minute quantities were identified essentially from their mass spectra: 2 (M^+ $C_9H_9NO_4S$) shows - in the same way as 1 - loss of $^{\cdot}SOCH_3$ (*m/z* 164) and of $^{\cdot}COSOCH_3$ (*m/z* 136), but starting from the latter it fragments typically for a $COOCH_3$ (*m/z* 136 - $^{\cdot}OCH_3$; *m/z* 136 - CO_2; *m/z* 136 - CO; $^{+}COOCH_3$) rather than for a $COSCH_3$ group.[3] 3 (M^+ $C_9H_9NO_4S_2$) also loses $^{\cdot}SOCH_3$ (*m/z* 196) and $^{\cdot}COSOCH_3$ (*m/z* 168). Loss of the second $COSOCH_3$ group then occurs by rearrangement processes analogous to those observed for the further degradation of $[M - {}^{\cdot}COSCH_3]^+$ from 4 as, e.g., loss of CO from *m/z* 168 followed by that of CH_2O (*m/z* 110) or $CH_3O^{\cdot}$ (*m/z* 109).[3]



1: R^1 = CO-$SOCH_3$, R^2 = $COSCH_3$
2: R^1 = CO-$SOCH_3$, R^2 = $COOCH_3$
3: R^1 = R^2 = CO-$SOCH_3$
4: R^1 = R^2 = $COSCH_3$

Treatment of the culture medium with CH_3CHN_2 yields the corresponding ethyl esters. From this observation it follows that the free acids rather than esters are the genuine metabolites. Their biogenetic significance lies in their intermediacy in the biosynthesis of pyridine-2,6-di(monothiocarbocylic acid) from pyridine-2,6-dicarboxylic acid

-COOH → -COSOH → -COSH

as was learned from feeding experiments with labelled precursors.[8]

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(Received in Germany 13 May 1985)