3-HYDROPEROXY-3-METHYL-2-PHENYL-3H-INDOLE
THERMAL DECOMPOSITION AND CHEMILUMINESCENCE

Masako Nakagawa,* Masakazu Sato, Yasuji Watanabe, and Tohru Hino

Faculty of Pharmaceutical Sciences, Chiba University, 1-33 Yayoi-cho, Chiba-shi, 260, Japan

and

Yasumaru Hatanaka and Yuichi Kanaoka

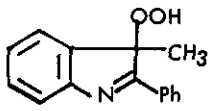
Faculty of Pharmaceutical Sciences, Hokkaido University, Sapporo, 060, Japan

Abstract —— Thermolysis of 3-hydroperoxy-3-methyl-2-phenyl-3H-indole 1 in dimethyl sulfoxide showed chemiluminescence and 3-hydroxy-3-methyl-2-phenyl-3H-indole 2 was obtained whereas in methanol 1 was converted to o-benzamidacetophenone. Deoxygenation occurred to give 2-phenylskatole on the termolysis of 1 in benzene.

Recently we have found that 3-hydroperoxy-3-methyl-2-phenyl-3H-indole 1 shows inhibitory effects on prostagrandin I_2 (PGI_2)synthetase [1]. In order to understand the stability of the compound 1, thermal decomposition of 1 was investigated.

When 1 (883 mg, 3.7 mmol) was heated in a test tube in dimethyl sulfoxide (2 ml) at 170°C, a chemiluminescence visible in dark was observed after 15 sec and continued for ca 40 sec. The reaction mixture was separated by silica gel chromatography and 3-hydroxy-3-methyl-2-phenyl-3H-indole 2 was obtained as the main product in 88% yield, together with an approximately equal amount of dimethyl sulfone, implying that the hydroperoxide 1 readily oxidized dimethyl sulfoxide to dimethyl sulfone. Small amounts of 2,3-bond cleavage compound 3 and indoxyl 5 which might arise from 2 under the reaction conditions were also isolated.

On the other hand, the 2,3-bond cleavage reaction became predominant to give the ketoamide 3 when refluxed in a protic solvent like methanol, accompanied by deoxygenation to the extent of about 10% to yield 2-phenylskatole. However, the thermolysis of 1 in benzene at reflux resulted in the formation of 2-phenylskatole 4 as the major product in 73% yield. Under these conditions (methanol or benzene reflux) there was virtually no chemiluminescence from these reactions. On direct heating



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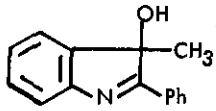

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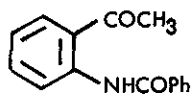

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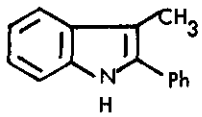

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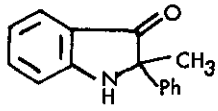

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Table 1 Thermolysis of 1 in Various Conditions

Solvent	Reaction Conditions		2	3	4	5	Me_2SO_2
DMSO	170° C	1 min	88%	4%	trace	1%	86%
MeOH	reflux	8 hr	2	78	11	0	
benzene	reflux	8 hr	14	13	73	0	
neat	157° C	1 min	14	48	2	trace	

1 without any solvent at 157° yielded chemiluminescence and 3 was obtained as the main product. The results are summarized in Table 1.

Many other indolyl hydroperoxides are known to emit light when decomposed either by a base or by heat [3]. The chemiluminescence spectrum from base-catalyzed decomposition of 3-hydroperoxy-indolenine has been obtained [2,3] and the anion of ketoamides was proposed as the light emitter on the basis of fluorescence measurements. In order to find out such chemiluminescence intermediate of 1 in our neutral conditions, the chemiluminescence spectrum from thermolysis of 1 was examined. The chemiluminescence spectrum obtained from 1 in dimethyl sulfoxide at 170°C showed a maximum at 570 nm (strong) and another chemiluminescence peak could be seen at 465 nm [4]. The ultraviolet absorption and fluorescence spectral data are listed in Table 2 [5]. The fluorescence spectrum of the major product 2 of the reaction in dimethyl sulfoxide, however, has a maximum at 420 nm and was not

Table 2 Ultraviolet Absorption and Fluorescence Spectra of the Reference Compounds

UV

Solvent	λmax nm (ε) 1	2	3	5
EtOH		312 (13700)	330 (7200)	398 (4000)
DMSO	317 (13300)	315 (15200)	331 (660)	

Fluorescence [5]

Solvent	1 λex	1 λem	2 λex	2 λem	3 λex	3 λem	5 λex	5 λem
EtOH			325	430	345	425, 525	400	470
DMSO	320	375	330	420	345	420, 525		

consistent with that of the chemiluminescence spectrum of 1. The fluorescence spectrum of the minor product 3 in dimethyl sulfoxide resembles the chemiluminescence spectrum of 1 and possesses two distinct peaks at 525 nm (strong) and 420 nm. However, there are a considerable shift (45 nm) from that of the chemiluminescence of 1. This difference may be due to the effect of the high temperature and/ or high concentration or that the emiting species is not the excited state of 3. Other products of the reaction have fluorescence maxima (4, 375 nm ; 5, 470nm) different from that of the chemiluminescence of 1. These results clearly show that the mode of decomposition of 1 was greatly influenced by the solvent used.

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4. Formylkynurenine and o-acetamidacetophenone have been reported to display unusual luminescence behaviors. Two fluorescence emission are seen whose quantum yield depends upon the solvent used. M.-P. Pileni, P. Walrant, and R. Santus, J.Phys.Chem., 1976, 80, 1804.

5. Fluorescence measurements were performed with a Hitachi MPF-2 spectrofluorometer. The transient spectrum of the chemiluminescence was obtained photographically with Fuji Neopan 400 film (ASA 400) by using a Nalumi grating spectrograph PM-23-1. The spectrum was corrected by using density-wavelengh correlation curve of the film used.

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