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HETEROCYCLIC ANALOGS OF PLEIADIENE. 75*. FORMYLATION OF PERIMIDINES AND 2,2-DIMETHYL-2,3-DIHYDROPERIMIDINE UNDER VILSMEIER CONDITIONS

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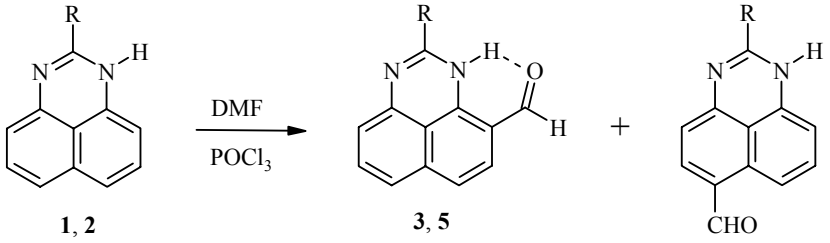
The formylation of perimidine, its 2- and 3-methyl derivatives, and 2,2-dimethyl-2,3-dihydroperimidine has been studied under the conditions of the Vilsmeier reaction. In the last case recyclization occurs. The characteristics of the ^{1}H NMR spectra of the aldehydes obtained are discussed.

Keywords: perimidine, the Vilsmeier reaction, recyclization, formylation.

In a continuation of an investigation of the formylation of perimidones, 2,3-dihydroperimidines, and 2-trifluoromethylperimidines [2], we have attempted to study the effect of the Vilsmeier reagent on perimidine and its simple derivatives. We have discovered, however, that they are formylated with considerably more difficulty than perimidones and 2,3-dihydroperimidines. For example, in the case perimidine (**1**) or 2-methylperimidine (**2**) a considerably greater amount of the Vilsmeier reagent than usual was required and the reaction only began at 80-90°C. The reaction occurred unexpectedly with the formation of poorly soluble oligomeric substances (^{1}H NMR data) from which the required monoaldehydes were separated with considerable difficulty. The basic products in the case of perimidine were 4(9)- **3** and 6(7)-carbaldehydes **4** the yields of each of which did not exceed 10%. Formylation of 2-methylperimidine occurred with even greater difficulty: the yields of the 4(9)-aldehyde **5** and the 6(7)-aldehyde **6** were ~2 and 1% respectively. A considerable amount of the starting materials was regenerated.



1, **2** **3**, **5** **4**, **6**

1, **3**, **4** R = H; **2**, **5**, **6** R = Me

* For part 74, see [1].

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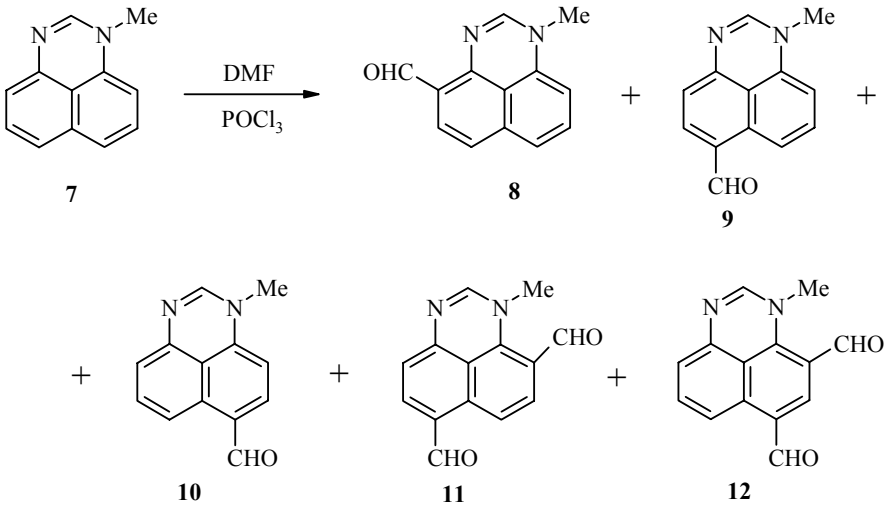
1-Methylperimidine (**7**) did not react with a 2-3 fold excess of the Vilsmeier reagent at 90-100°C in 6 h. The 4-aldehyde **8** (7%) and a mixture (12%) of the 6- and 7-aldehydes, **9** and **10**, were obtained with a 5-fold excess of the formylating medium (80-90°C, 4 h). The rate of the process increased notably with a 7.5-fold excess of the Vilsmeier reagent. The 6,9- (**11**) and 7,9-dialdehydes (**12**) were isolated unexpectedly along with the monoaldehydes **8-10**. The yields of compounds **8-12** were 5, 6, 6, 9, and 5% respectively; however 47% of the starting material was regenerated. Unfortunately, both the dialdehydes, **11,12**, and the 6- and 7-monoaldehydes **9,10** could not be separated because their chromatographic mobilities were identical. However their identification *via* ^{1}H NMR spectroscopy was not difficult because of specific characteristics for each of the aldehydes.

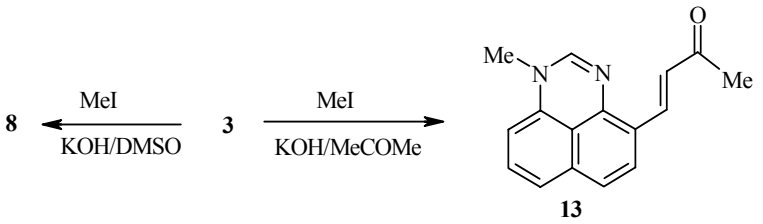


7 **8** **9** **10** **11** **12**

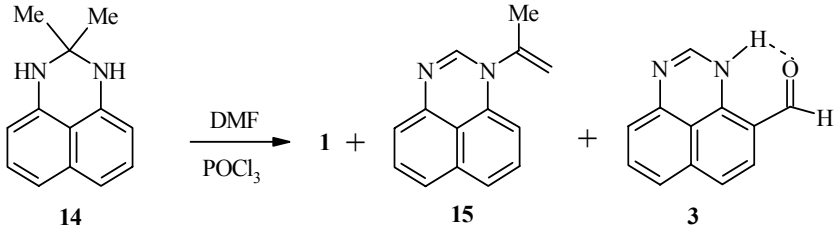
It is possible the low reactivity of the perimidines is explained by their relatively high basicity. For example, the pK_a of compounds **1**, **2**, and **7** in acetonitrile are 13.58, 14.70 [3], and 13.79 [4], which is considerably greater than those of 1,3-dimethyl- and 1,2,2,3-tetramethyl-2,3-dihydroperimidines (pK_a 8.67 and 10.51 respectively) and much greater than perimidones (pK_a < 5) [5]. As a result the perimidines **1**, **2**, and **7** under the conditions of the Vilsmeier reaction exist to a considerable extent as the protonated or N-phosphorylated forms, the activity of which with electrophiles is considerably decreased. Confirmation of the considerable importance of the basicity factor is confirmed by the ready formylation of the poorly basic 2-trifluoromethylperimidine [2] (the pK_a of its N-methyl derivative is 6.64 [6]) and 1,2-diazaphenalenes [7] (pK_a< 3). In a special reaction we showed that, in distinction from nitration and acylation [8], the 1,3-dimethylperimidinium cation did not react under Vilsmeier conditions.

In addition, N-phosphorylperimidines, like N-acylperimidines [9], should be hydrolytically very unstable and the heterocycle opens readily in the presence of even traces of water and other nucleophiles. This may be one reason for the formation of oily and oligomeric substances during the formylation of perimidines **1** and **2**, which contain free NH groups. This is related to the formation of small amounts of the dialdehydes **11** and **12** which arises from the presence in the Vilsmeier reagent of the $CHClNMe_2$ group [10, 11], although it possesses scarcely any acceptor effect and consequently does not create a large tendency for a second attack of the electrophile. Nevertheless, the formation of **12** is a very rare example of double Vilsmeier formylation in a single benzene ring [2, 12].

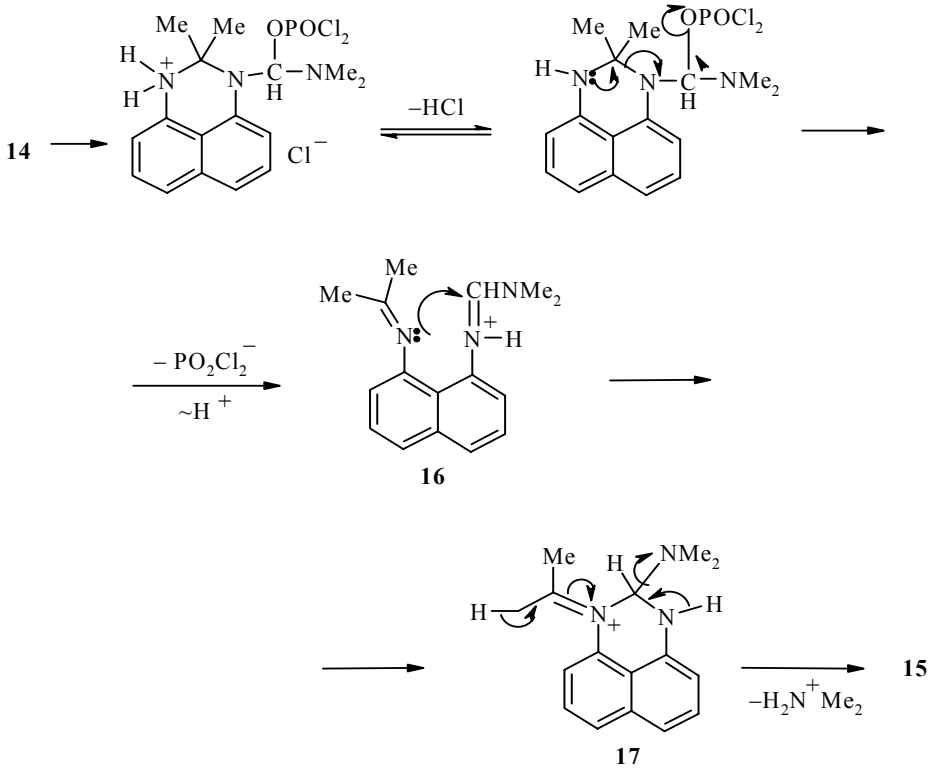
The reaction of aldehyde **3** with MeI in the KOH/DMSO system gave 1-methylperimidine-4-carbaldehyde (**8**), as in other similar cases [8,13]. The 9-CHO group completely blocks the neighboring nitrogen atom. When the reaction was carried out in the presence of acetone (or in a KOH/acetone system), methylation was accompanied by crotonic condensation to give 4-(1-methylperimidinyl-4)buten-3-one (**13**) in 72% yield:



In connection with the completely unusual results of formylation of 1,3-dimethyl- and 1,2,2,3-tetramethyl-2,3-dihydroperimidines [2], it seemed of interest to study their analog with free NH groups, 2,2-dimethyl-2,3-dihydroperimidine (**14**). We established that compound **14** reacted with the Vilsmeier reagent in a completely different manner: unexpectedly perimidine (**1**), 1-isopropenylperimidine (**15**), and the aldehyde **3** were isolated from the reaction mixture in yields of 52, 13, and 4 % respectively. In addition 18% of the starting dihydroperimidine **14** was regenerated.



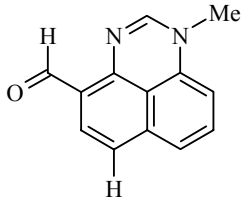
It is evident that the formation of the perimidines is the result of recyclization of compound **14**. For example, formation of 1-propenylperimidine (**15**) may occur as a result of attack of the Vilsmeier reagent on compound **14** at a nitrogen atom with subsequent opening of the heterocyclic ring and a second cyclization, accompanied by elimination in the intermediate **17**.



If hydrolysis of the N=CMe$_2$ accompanies the cyclization of the amidine **16**, the product is perimidine **1**. As for the aldehyde **3** it is most likely obtained by recyclization of 4-formyl-2,2-dimethyl-2,3-dihydroperimidine, formed in small amounts, since perimidine does not undergo the Vilsmeier reaction under these conditions.

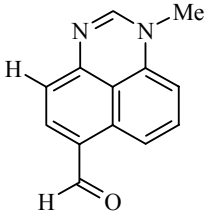
In the ^{1}H NMR spectra of the aldehydes obtained the chemical shifts of the protons of the CHO group and the nearby *peri* and (to a lesser extent) *ortho* protons. The structures of the aldehydes **3** and **5** with an unsubstituted NH groups can be determined by the characteristic weak field position of the proton of the NH group (~ 11.9 ppm).

The 6(7)-formyl group strongly deshields the *peri*-hydrogen atom, the signal of which is shifted to the 8.6-8.7 region. In our view this indicates that the carbonyl oxygen is oriented towards the *peri* proton (*Z*-conformation). We have confirmed this conformation previously in the case of 6(7)-formyl-2-trifluoromethylperimidine by X-ray crystallography [14]. The signals of the protons of the 4- and 9-CHO group in aldehydes **8**, **11**, and **12** are shifted to weak field by ~0.7-0.8 ppm in comparison with the protons of the 6- and 7-CHO group (aldehydes **3** and **5** are excluded from the comparison since hydrogen bonding fixes the formyl group in the plane of the ring). While in aldehydes **11** and **12** this is evidently caused by rotation of the 9-CHO relative to the ring system, in the case of compound **8** the aldehydic proton is oriented in the direction of the pyridine nitrogen atom which descreens it. In other words, the *E*-conformation is preferable for aldehyde **8**. As in other similar cases, the *trans* position of the hydrogen atom of the CHO group and H-6 of aldehyde **8** leads to a long range coupling constant, ^5J. No similar ^5J coupling constant is observed with the *cis* position of these atoms in the other aldehydes which have a *Z*-conformation. All of these features make it easy to establish the formyl groups in the monoaldehydes and attribute unambiguously the signals of the protons of the CHO in the dialdehydes.



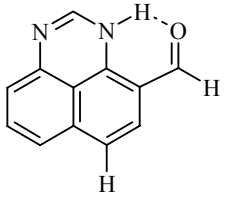
8

E-conformation,
(^5J = 0.48 Hz)



9

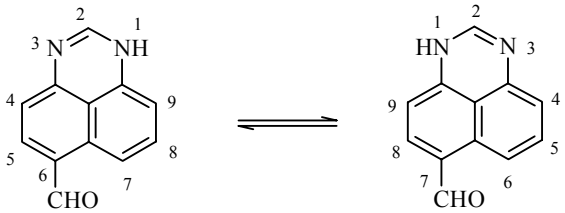
Z-conformation,
(^5J = 0 Hz)



3

Z-conformation,
(^5J = 0 Гц)

The characteristic feature of the ^{1}H NMR spectrum of 6(7)-formylperimidine (**4**) (Fig. 1) which distinguishes it from the spectra of perimidine and 2-methylperimidine is the considerable broadening of the H-4 and H-9 signals as a result of which the resolution of the multiplet structure is completely lost. Evidently this is the result of slow annular tautomerism which probably exchanges the protons of the naphthalene ring closest to the heteroatoms. As Fig. 1 shows, when the solution of aldehyde **4** in DMSO-d$_6$ is heated to 120°C the signals of these protons are sharply narrowed which indicates the acceleration of the proton exchange between the protons of the non-degenerate tautomers **4a** and **4b**.



4a **4b**

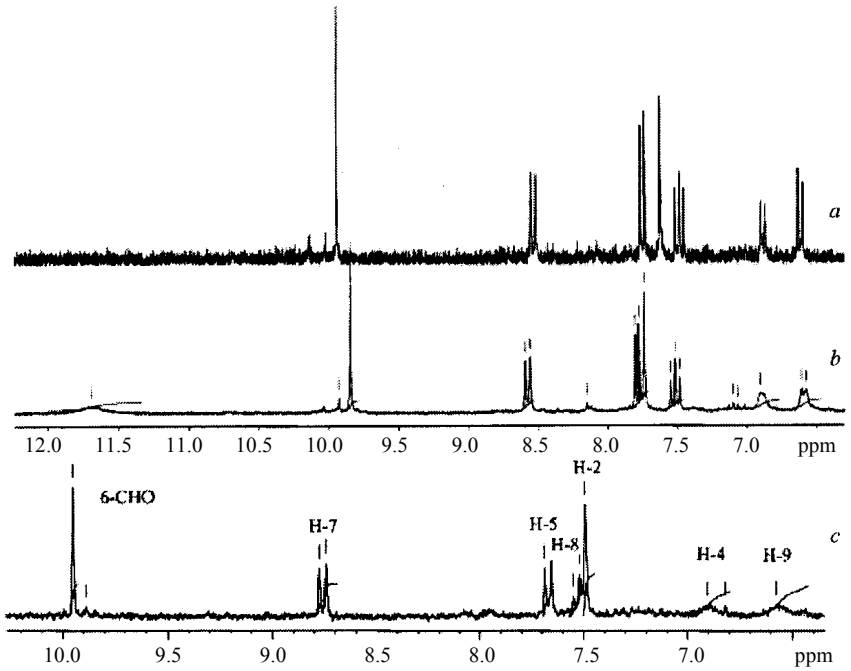


Fig. 1. ^{1}H NMR spectra of perimidin-6(7)-carbaldehyde (**4**):
a – in DMSO-d_6, 120°C (250 MHz); *b* - in DMSO-d_6,25°C; in $CDCl_3$, 25°C

To judge from the relative heights of the peaks, the signal of H-4(9) in the same ring as the CHO group is found at stronger field (6.59 ppm) than the CHO group. The signal of the other proton, also *ortho* to the heterocycle, is somewhat lower in height because of additional *meta* splitting and appears at 6.9 ppm. The signal of the NH proton is lost in the baseline at higher temperature.

EXPERIMENTAL

^{1}H NMR spectra were recorded on a Unity-300 (300 MHz) machine with TMS as internal standard. UV spectra were recorded with a Specord M-40 spectrophotometer, infrared spectra with UR-20 spectrometer, and mass spectra with an MX-1321A machine with direct insertion of the samples at the temperature of the ionization chamber (50-100°C) and an ionizing voltage of 70 eV. Chromatography was carried out using Brockman aluminum oxide of activity III and also on Chemapol L40/100 silica gel. Melting point were determined in sealed capillaries with a PTP apparatus and were not corrected.

Formylation of Perimidine (1). $POCl_3$ (3.85 ml, 42 mmol) was added dropwise to dry DMF (8 ml) cooled to 0°C and the mixture was stirred for 30 min at room temperature. A solution of perimidine (1.008 g, 6 mmol) in DMF (22 ml) was added to the Vilsmeier reagent, the mixture was stirred at 70-75°C for 90 min and then for a further 40 min at 80-90°C. The brownish precipitate was filtered off and discarded (according to ^{1}H NMR data it was a mixture of oligomers). The filtrate was extracted with chloroform (6 × 50 ml), the extract was evaporated to give yellow-green crystals (0.58 g), which were purified by chromatography on alumina (l = 15 cm, d = 1.5 cm) and eluted with 3:1 $CHCl_3$–acetone. The first two fractions were yellowish. From the first fraction yellow crystals (0.01 g) were obtained, mp 135-136°C (acetone), with an undetermined structure. To judge from spectroscopic data, it contained an aldehyde group (9.92 ppm, $\nu_{C=O}$ 1653 cm^{-1}), two non-equivalent dimethylamino groups (2.91 and 3.18 ppm), and a chlorine atom. Pure **perimidine-9-carbaldehyde (3)** (0.12 g, 10%, R_f 0.23 (4:1 $CHCl_3$–acetone)) was isolated from the second fraction. Yellow needles;

mp 152-154°C, (benzene–petroleum ether). IR spectrum (nujol mull), ν, cm^{-1}: 3433 (br, N–H), 3233 (sh, N–H), 1647 (ring), 1633 (C=O). ^{1}H NMR spectrum ($CDCl_3$), δ, ppm (*J*, Hz): 7.10 (1H, d, J_{78} = 8.83, H-7); 7.19 (1H, dd, J_{45} =7.7, H-4); 7.32 (1H, d, J_{87} =8.83, H-8); 7.35 (1H, dd, J_{65} = 7.90, H-6); 7.60 (1H, dd, J_{54} = 7.7, J_{56} = 7.90, H-5); 7.75 (1H, d, $J_{2\text{-NH}}$ = 2.97, H-2); 9.80 (1H, s, 9-CHO); 11.90 (1H, br. s, NH). Found, %: C 73.50; H 3.99; N 13.97. $C_{12}H_8N_2O$. Calculated, %: C 73.45; H 4.11; N 14.28.

The orange colored starting zone was cut from the chromatographic column and extracted with acetone to give, after evaporation of the solvent, deep orange crystals of **perimidine-6(7)-carbaldehyde (4)**, (0.08 g, 7%); mp 212-214°C (acetonitrile–petroleum ether), R_f 0.06. UV spectrum (CH_3OH), λ_{max}, nm (log ε): 326 (3.79), sh 337 (3.75), 458 (3.99), sh 478 (3.95). IR spectrum (nujol mull), ν, cm^{-1}: 3167 (br, N–H), 1660, 1640, 1633 (superimposed C=O peaks caused by the formation of associates), 1607, 1567 (ring). ^{1}H NMR spectrum ($CDCl_3$), δ, ppm (*J*, Hz): 6.58 (1H, br. s, H-9); 6.91 (1H, br. s, H-4); 7.50 (1H, s, H-2); 7.53 (1H, dd, J_{87} = 8.88, J_{89} = 8.31, H-8); 7.68 (1H, d, J_{54} = 8.12, H-5); 8.77 (1H, dd, J_{78} = 8.88, H-7); 9.96 (1H, s, 6-CHO). ^{1}H NMR spectrum (DMSO-d_6), δ, ppm (*J*, Hz) at 25°C: 6.59 (1H, br. d, J_{45} = 7.52. H-4); 6.90 (1H, br. s, H-9); 7.52 (1H, dd, J_{87} = 8.21, J_{89} = 7.94, H-8); 7.75 (1H, s, H-2); 7.80 (1H, d, J_{54} = 7.95, H-5); 8.58 (1H, d, J_{78} = 8.21. H-7); 9.85 (1H, s, CHO); 11.70 (1H, br. s, NH): at 120°C: 6.62 (1H, d, J_{45} = 7.89, H-4); 6.88 (1H, br. d, J_{98} = 6.85, H-9); 7.49 (1H, dd, J_{87} = 8.44, J_{89} = 8.53, H-8); 7.63 (1H, s, H-2); 7.76 (1H, d, J_{54} = 7.89, H-5); 8.54 (1H, dd, J_{78} = 8.44, J_{79} = 0.87, H-7); 9.95 (1H, s, 6-CHO). Found, %: C 73.28; H 4.03; N 14.04. $C_{12}H_8N_2O$. Calculated, %: C 73.45; H 4.11; N 14.28.

Formylation of 2-Methylperimidine (2). 2-Methylperimidine (0.55g, 3 mmol) in DMF (25 ml) was added in portions to Vilsmeier reagent prepared from DMA (5 ml) and phosphorus oxychloride (1.65 ml, 13 mmol). A copious yellow-green precipitate was formed immediately. The reaction mixture was stirred at about 70°C for 2h 30 min and then for 90 min at 60-65°C. After cooling the dark yellow precipitate of 2-methyperimidinium chloride (0.35 g, 33%) was filtered off, washed with chloroform, and dried in vacuum.

The filtrate was poured into water (50 ml), neutralized with 10% NH_4OH to pH ~8, and extracted with chloroform (~250 ml). The solution was evaporated and the dark brown oily residue was chromatographed on an alumina column (*l* = 18 cm, *d* = 1 cm) in chloroform. The first three fractions were collected. **2-Methylperimidine-9-carbaldehyde (5)** (0.012 g, 2%) was obtained from the first fraction, starting material **2** (0.08 g, 14%) from the second, and **2-methylperimidine-6(7)-carbaldehyde (6)** (5 mg, 1%) from the third.

2-Methylperimidine-9-carbaldehyde (5). Yellow crystals; mp 159-161°C (octane). ^{1}H NMR spectrum ($CDCl_3$), δ, ppm (*J*, Hz): 2.40 (3H, s, 2-CH_3); 7.08 (1H, d, J_{78} = 8.81, H-7); 7.14 (1H, br d, J_{45} = 7.52, H-4); 7.30 (1H, br d, J_{65} = 8.03, H-6); 7.33 (1H, d, J_{87} = 8.81, H-8), , 7.59 (1H, dd, J_{54} = 7.52, J_{56} = 8.03, H-5); 9.79 (1H, s, 9-CHO); 11.87 (1H, br. s, NH). Found, %: C 74.20; H 4.92; N 13.52. $C_{13}H_{10}N_2O$. Calculated, %: C 74.26; H 4.80; N 13.33.

2-Methylperimidine-6(7)-carbaldehyde (6). Deep-orange crystals; mp 196-198°C (octane). ^{1}H NMR spectrum ($CDCl_3$), δ, ppm (*J*, Hz): 2.28 (3H, s, 2-CH_3); 6.58 (1H, br. d, J_{45} = 7.73, H-4); 6.84 (1H, br. d, J_{98} = 7.90, H-9); 7.51 (1H, dd, J_{87} = 8.71, J_{89} = 7.90, H-8); 7.67 (1H, d, J_{54} = 7.73, H-5); 8.72 (1H, d, J_{78} = 8.71, H-7); 9.95 (1H, s, 6-CHO). Found, %: C 74.01; H 4.52; N 13.20. $C_{13}H_{20}N_2O$. Calculated, %: C 74.26; H 4.80; N 13.33.

Formylation of 1-Methylperimidine (7). $POCl_3$ (1.4 ml, 15 mmol) was added dropwise to dry DMF (5 ml) at 0°C. Then 1-methylperimidine (0.364 g, 2 mmol) in DMF (15 ml) was added and the solution was heated at 70-75°C for 2 h. After cooling the mixture was poured into water (60 ml), and neutralized with 10% NH_4OH to about pH 8-9. The orange emulsion was extracted with chloroform (about 250 ml), and the extract was evaporated to give an orange-brown oil (0.42 g). It was dissolved in a minimal amount of chloroform and chromatographed in chloroform on an alumina column (*l* = 20 cm, *d* = 1.5 cm). The starting material was eluted first with R_f 0.26 ($CHCl_3$), yield 0.17 g, 47%. Two more fractions were collected, the first of which contained predominantly a mixture of the 4-, 6-, and 7-carbaldehydes **8**, **9**, and **10** respectively, while second contained mainly the 6,9- and 7,9-dicarbaldehydes **11** and **12.** They were finally separated by preparative TLC on Al_2O_3

with a 3:1 $CHCl_3$–acetone mixture as eluent, to give pure 4-aldehyde **8** (0.022 g, 5%, R_f 0.3 (3:1 $CHCl_3$–acetone)), a mixture of the 6- and 7-aldehydes **9** and **10** (0.05 g, 12%, R_f 0.23 (3:1 $CHCl_3$–acetone)), and a mixture of the dialdehydes **11** and **12** (0.06 g, 14%, R_f 0.09 (3:1 $CHCl_3$–acetone)). The ratios of aldehydes **9:10** = 1:1 and **11:12** = 5:3 according to ^{1}H NMR data.

1-Methylperimidine-4-carbaldehyde (8). Yellow crystals; mp 170-172°C (octane). IR spectrum (nujol mull), ν, cm^{-1}: 3227 (NH), 1660 (C=)), 1647, 1627, 1600, 1580 (ring). ^{1}H NMR spectrum ($CDCl_3$), δ, ppm (*J*, Hz): 3.32 (3H, s, $N_{(1)}$-CH_3); 6.38 (1H, br. d, J_{98} = 7.45, H-9); 7.13 (1H, dd, J_{65} = 8.81, $J_{6H\text{-}CHO}$ = 0.48, H-6); 7.22 (1H, br. d, J_{78} = 8.58, H-7); 7.38 (1H, dd, J_{87} = 8.58, J_{89} = 7.45, H-8); 7.50 (1H, s, H-2); 7.72 (1H, d, J_{56} = 8.81, H-5); 10.73 (1H, d, $J_{CHO\text{-}6H}$ = 0.48, 4-CHO). Found, %: C 74.12, H 4.88, N 13.05. $C_{13}H_{10}N_2O$. Calculated, % C 74.26; H 4.80; N 13.33.

1-Methylperimidine-6-carbaldehyde (9) was obtained as a mixture with isomer **10**. ^{1}H NMR spectrum ($CDCl_3$), δ, ppm (*J*, Hz): 3.33 (3H, s, $N_{(1)}$–CH_3); 6.95 (1H, d, J_{45} = 7.88, H-4); 7.18 (1H, dd, J_{98} = 7.53, J_{97} = 0.77, H-9); 7.50 (1H, dd, J_{87} = 8.65, J_{89} = 7.53, H-8); 7.55 (1H, s, H-2); 7.78 (1H, d, J_{54} 7.88, H-5); 8.83 (1H, dd, J_{78} = 8.65, J_{79} = 0.77, H-7); 10.02 (1H, s, CHO).

1-Methylperimidine-7-carbaldehyde (10) was obtained as a mixture with isomer **9**. ^{1}H NMR spectrum ($CDCl_3$), δ, ppm (*J*, Hz): 3.35 (3H, s, $N_{(1)}$–CH_3); 6.27 (1H, d, J_{98} = 8.04, H-9); 6.52 (1H, dd, J_{45} = 7.92, J_{46} = 0.45, H-4); 7.46 (1H, s, H-2); 7.61 (1H, dd, J_{54} = 7.92, J_{56} = 8.54, H-5); 7.68 (1H, d, J_{89} = 8.04, H-8); 8.84 (1H, dd, J_{65} = 8.54, J_{64} = 0.45, H-6); 9.92 (1H, s, 7-CHO).

1-Methylperimidine-6,9-dicarbaldehyde (11) was obtained as a mixture with isomeric dialdehyde **12**. ^{1}H NMR spectrum ($CDCl_3$), δ, ppm (*J*, Hz): 3.46 (3H, s, $N_{(1)}$–CH_3); 6.47 (1H, d, J_{45} = 8.19, H-4); 7.62 (1H, s, H-2); 7.83 (1H, d, J_{54} = 8.18, H-5); 7.98 (1H, d, J_{87} = 9.04, H-8); 8.71 (1H, d, J_{78} = 9.03, H-7); 10.01 (1H, s, 6-CHO); 10.79 (1H, s, 9-CHO).

1-Methylperimidin-7,9-dicarbaldehyde (12) was obtained as a mixture with isomeric dialdehyde **11**. ^{1}H NMR spectrum ($CDCl_3$), δ, ppm (*J*, Hz): 3.51 (3H, s, $N_{(1)}$–CH_3); 6.74 (1H, d, J_{45} = 7.83, H-4); 7.68 (1H, dd, J_{54} = 7.83, J_{56} = 8.52, H-5); 7.76 (1H, s, H-2); 8.23 (1H, s, H-8), 8.91 (1H, br. d, J_{65} = 8.52, H-6); 9.99 (1H, s, 7-CHO); 10.71 (1H, s, 9-CHO).

Methylation of Perimidine-9-carbaldehyde. A stream of dry argon was passed through a solution of aldehyde **3** (0.06 g, 0.3 mmol) in DMSO for 10 min and then pulverized KOH (18 mg, 0.3 mmol) was added. The mixture was stirred for 5 min in a stream of argon and methyl iodide (0.1 ml, 1.6 mmol) was added. More methyl iodide (0.05 ml , 0.8 mmol) was added over 1 h, stirring was continued for 40 min at room temperature, the mixture was poured into water (15 ml), and extracted with chloroform (60 ml). The solution was evaporated to small volume and passed through an Al_2O_3 column with $CHCl_3$ (*l* = 12 cm, *d* = 1.5 cm). The basic fraction collected had a yellow color and consisted of **1-methylperimidine-4-carbaldehyde (8)** (0.03 g, 47%). The compound did not give a melting point depression with a sample prepared by formylation of 1-methylperimidine.

4-(1-Methylperimidinyl-4-buten-3-one (13). A solution of aldehyde **3** (0.021 g, 0.1 mmol) and pulverized KOH (0.006 g, 0.1 mmol) in DMSO (3 ml) and acetone (2 ml) was kept at room temperature for 1.5 h, after which it was evaporated to dryness and chromatographed on a column (*l* = 8 cm, *d* = 1 cm) in chloroform. A single fraction was collected, compound **13**. The golden orange crystals were insoluble in bases but soluble in acids to give a deep red solution. Yield 0.018 g (72%); mp 195-197°C (octane). IR spectrum (nujol mull), ν, cm^{-1}: 1660 (C=O), 1623, 1580, 1554 (ring), 1600 (CH=CH). Mass spectrum, *m/z* (I_{rel}, %): 250 $[M]^+$ (23), 222 $[M - CO]^+$ (17), 207 $[M - COCH_3]^+$ (100), 197 $[207 - CH_3]^+$ (45). ^{1}H NMR spectrum ($CDCl_3$), δ, ppm (*J*, Hz): 2.41 (3H, s, 1-CH_3); 3.25 (1H, s, N-CH_3); 6.28 (1H, dd, $J_{9'8'}$ = 7.74, $J_{9'7'}$ = 0.66, H-9'); 6.64 (1H, d, J_{trans} = 16.53, H-3); 7.13 (1H, d, $J_{5'6'}$ = 8.87, H-5'); 7.16 (1H, dd, $J_{7'8'}$ = 7.42, $J_{7'9'}$ = 0.66, H-7'); 7.24 (1H, dd, $J_{8'9'}$ = 7.74, $J_{8'7'}$ = 7.42, H-8'); 7.42 (1H, s, H-2'); 7.52 (1H, d, $J_{6'5'}$ = 8.87, H-6'); 8.38 (1H, d, J_{trans} = 16.53, H-4). ^{1}H NMR spectrum (DMSO-d_6), δ, ppm (*J*, Hz): 2.29 (3H, s, 1-CH_3); 3.29 (1H, s, N–CH_3); 6.50 (1H, br. d, $J_{9'8'}$ = 7.30, H-9'); 6.72 (1H, d, J_{trans} = 16.48, H-3); 7.16 (1H, d, $J_{5'6'}$ = 8.81, H-5'); 7.22 (1H, d, $J_{7'8'}$ = 8.12, H-7');

7.35 (1H, dd, $J_{8'7'}$ = 8.12, $J_{8'9'}$ = 7.30, H-8'); 7.63 (1H, d, $J_{6'5'}$ = 8.81, H-6'); 7.80 (1H, s, H-2'); 8.30 (1H, s, J_{trans} = 16.48, H-4). Found, %: C 76.82; H 5.70; N 11.02. $C_{16}H_{14}N_2O$. Calculated,%: C 76.78; H 5.64; N 11.19.

Formylation of 2,2-Dimethyl-2,3-dihydroperimidine (14). $POCl_3$ (0.69 ml, 7.5 mmol) was added dropwise with cooling to 0°C to dried and freshly distilled DMF (5 ml) and the mixture was stirred for 20 min at -20°C. A solution of compound **14** (0.5 g, 2.5 mmol) in DMF (15 ml) was added to the Vilsmeier reagent. The reaction mixture was heated at 65-70°C for 2 h. After cooling, the precipitated perimidinium chloride was filtered off and treated with 10% NaOH. After filtration and drying pure perimidine **1** was obtained (0.15 g).

The filtrate after removing the perimidinium chloride was poured into water (60 ml) and made alkaline to about pH 8 by treatment with 10% aqueous NH_4OH. The orange emulsion formed was extracted with chloroform, and the solvent evaporated to give an oily brown residue (0.3 g). Further separation was carried out by preparative TLC on Al_2O_3 with $CHCl_3$ as eluent. The products obtained were **1-isopropenylperimidine (15)** (0.07 g, 13%, R_f 0.64), **perimidine-9-carbaldehyde (3)** (0.025 g, 4%, R_f 0.23), the dihydroperimidine starting material **14** (0.09 g, 18%, R_f 0.16), and perimidine **1** (0.07 g, R_f 0.11). So the overall yield of perimidine was 0.22 g (52%).

1-Isopropenylperimidine (15) – a dark yellow oil. ^{1}H NMR spectrum ($CDCl_3$), δ, ppm (J, Hz): 2.03 (3H, d, J_{CH3-H} = 0.47, CH_3); 5.23 and 5.30 (1H each, br. s, =CH_2); 6.12 (1H, dd, J_{98} =5.41, J_{97} = 2.14, H-9); 6.82 (1H, dd, J_{45} = 7.03, J_{46} = 1.01, H-4); 7.09 (2H, m, H-6,7); 7.18 (3H, m, H-2,5,8). Found, %: C 80.43; H 5.92; N 13.16. $C_{14}H_{12}N_2$. Calculated, %: C 80.74; H 5.81; N 13.45.

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