Synthesis of (±)-Glaucine and (±)-Neospirodienone *via* an One-Pot *Bischler–Napieralski* Reaction and Oxidative Coupling by a Hypervalent Iodine Reagent

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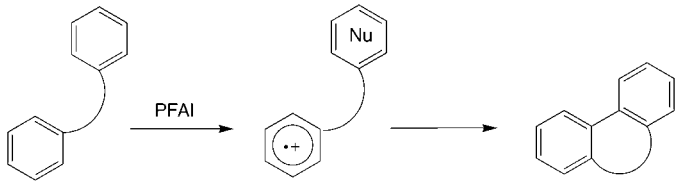
Condensation of 3,4-dimethoxybenzeneethanamine (**3d**) and various benzeneacetic acids, *i.e.*, **4a**–**e**, *via* a practical and efficient one-pot *Bischler–Napieralski* reaction, followed by $NaBH_4$ reduction, produced a series of 1-benzyl-1,2,3,4-tetrahydroisoquinolines, *i.e.*, **5a**–**e**, in satisfactory yields (*Scheme 3*). Oxidative coupling of the *N*-acyl and *N*-methyl derivatives **6a**–**e** of the latter with hypervalent iodine ($[IPh(CF_3COO)_2]$) yielded products with two different skeletons (*Scheme 4*). The major products from *N*-acyl derivatives **6a**–**c** were (±)-*N*-acylneospirodienones **2a**–**c**, while the minor was the 3,4-dihydroisoquinoline **7**. (±)-Glaucine (**1**), however, was the major product starting from *N*-methyl derivative **6e**. Possible reaction mechanisms for the formation of these two types of skeleton are proposed (*Scheme 5*).

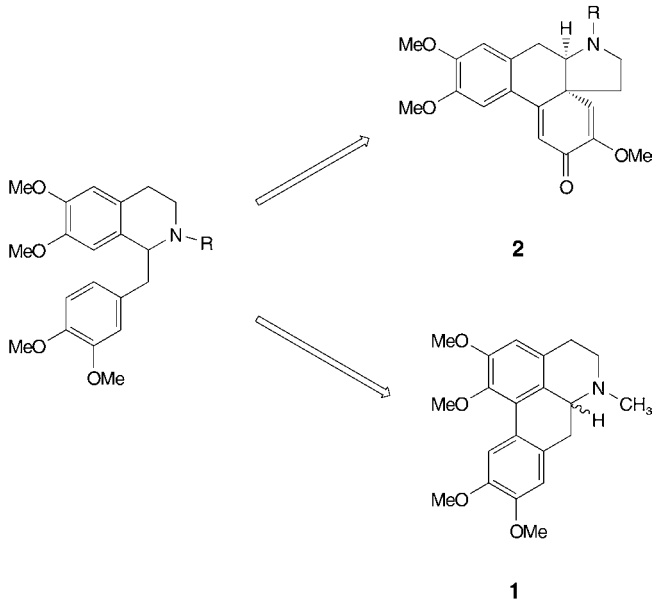
Introduction. – Glaucine (**1**), a naturally occurring aporphine alkaloid, was recently demonstrated to be a potent anti-inflammatory agent [1]. It had been prepared by oxidative coupling of 1-(3,4-dimethoxybenzyl)-1,2,3,4-tetrahydro-6,7-dimethoxy-2-methylisoquinoline with some oxidative reagents such as V^{III}, Cr^{III}, and Pb^{IV} [2–4]. These reagents, however, are usually difficult to handle and have all toxic properties, which limit their application for large-scale synthesis. During the past decade, arylbis(alkanoato-κO)-iodines (= [bis(acyloxy)iodo]arenes) have been widely used as oxidation agent. Among them, $[IPh(CF_3COO)_2]$ (PFAI) possesses an oxidation property equivalent to that of Th^{III}, Hg^{II}, and Pb^{IV} [5] but is devoid of toxic properties. More recently, PFAI has been used for the generation of aryl radical cations *via* a single-electron-transfer (SET) pathway (*Scheme 1*) [6]. The intermediate could be trapped by the internal or external nucleophiles such as azide [6a], thiocyanide [7], and others [8], which afforded the substituted benzene rings. We thought that intramolecular coupling of two sets of aryl radical cations would give rise to a new biarene connection. We now describe our efforts to reach this goal, which led to the synthesis of (±)-glaucine (**1**) and (±)-neospirodienones **2** starting from a 1-benzyl-1,2,3,4-tetrahydroisoquinoline (*Scheme 2*).

Result and Discussion. – During the preparation of the amide by condensation of benzeneethanamine (**3d**) and benzeneacetyl chloride, prepared *in situ* by reacting the carboxylic acid **4a** with phosporyl chloride ($POCl_3$), two products were obtained. The less polar one was the expected corresponding amide. The polar one showed a positive response to *Dragendorff*'s reagent, suggesting the presence of an amine formed by subsequent *Bischler–Napieralski* reaction of the amide with the excess of the reagent

Scheme 1. *Intramolecular Oxidative Coupling with PFAI*



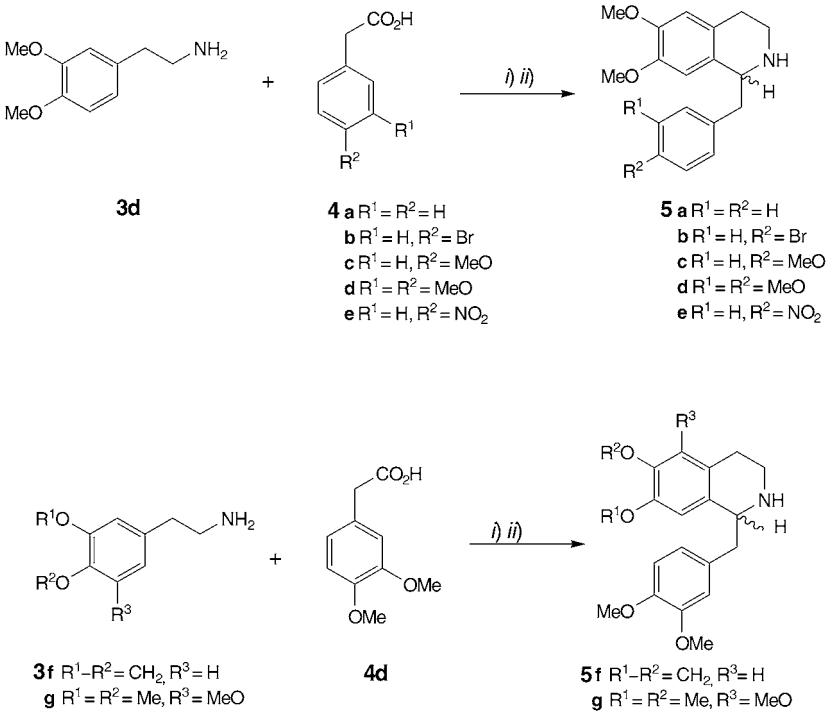
Scheme 2



$POCl_3$. Optimization of the reaction conditions revealed that, with 4 equiv. of $POCl_3$, this amine product was formed exclusively. Previous studies [9] had indicated the air sensitivity of the amines produced in this reaction, *i.e.*, of the 1-benzyl-3,4-dihydroisoquinolines. Thus without further purification, the amines were reduced by $NaBH_4$ to give the stable 1-benzyl-1,2,3,4-tetrahydroisoquinolines. Application of this facile approach resulted in the synthesis of the benzyltetrahydroisoquinolines **5a**–**e** from amine **3d** and corresponding benzeneacetic acids **4a**–**e** in satisfactory yields (*Scheme 3*, *Table 1*). The poor solubility of 4-nitrobenzeneacetic acid (**4e**) in $POCl_3$ impeded the formation of the corresponding amide, and thus a longer reaction time (24 h) for a better yield of **5e** was required. under similar conditions, reaction of the benzeneethanamines **3f**,**g** with **4d** also afforded the corresponding products **5f**,**g** in satisfactory yields (*Scheme 3*, *Table 1*).

Reaction of the benzyltetrahydroisoquinoline **5d** with trifluoroacetic anhydride ($(CF_3CO)_2O$) in pyridine yielded the *N*-trifluoroacetyl derivative **6a**. Treatment of **6a** with PFAI (1.2 equiv.) in the presence of $BF_3 \cdot Et_2O$ (2.6 equiv.) in CH_2Cl_2 at $-40°$ gave

Scheme 3



i) $POCl_3$, PhMe, r.t. to 120°, 3.5 h. *ii*) $NaBH_4$, MeOH, r.t., 2.5 h.

Table 1. *1-Benzyl-1,2,3,4-tetrahydroisoquinolines* **5** *Prepared* via *a One-Pot* Bischler–Napieralski *Reaction*

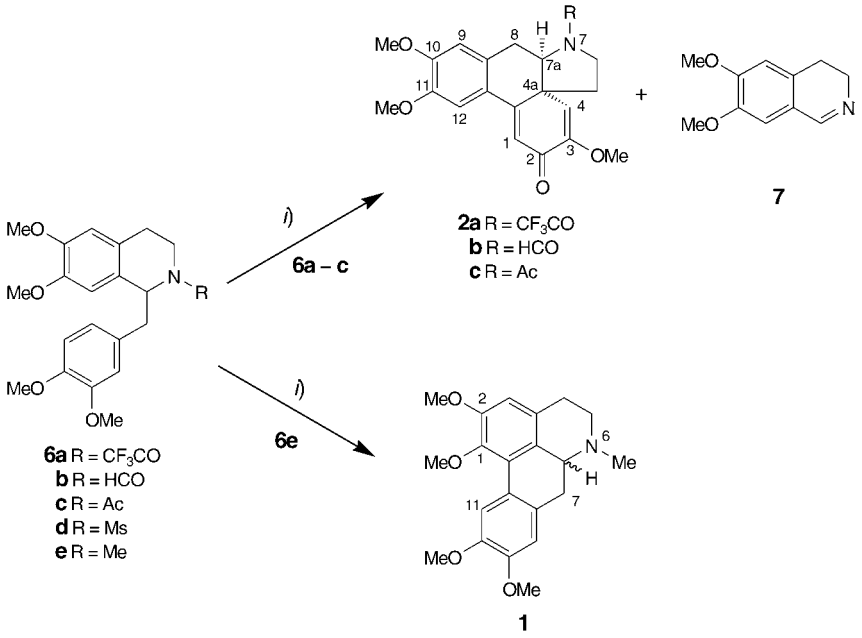
	5a	**5b**	**5c**	**5d**	**5e**	**5f**	**5g**
Yield[a]) [%]	75	73	75	70	65	78	71
M.p. (Lit. m.p.) [°]	–	–	88–90 ([10]: 89–91)	78–80 ([11]: 76–77)	130–132 ([12]: 134–136)	84–86 ([13]: 82–84)	92–94 ([14]: 91–92)

[a]) Yield of isolated product.

dihydroisoquinoline **7** [15] (46%) and an unexpected racemic compound **2a** (42%) (*Scheme 4*). Compound **2a** was identified as (±)-*N*-(trifluoroacetyl)neospirodienone, which had been prepared previously by treating morphinandienone with $VOF_3 \cdot CF_3COOH$ *via* a rearrangement mechanism [16], by comparison of its spectral data to those reported.

The molecular formula $C_{21}H_{21}F_3NO_5$ of **2a** was deduced from the HR-FAB-MS, exhibiting a quasi-molecular ion $[M+H]^+$ at *m/z* 424.1367. The ^{1}H-NMR spectrum showed two sets of signals due to the existence of s-*trans* and s-*cis* forms of the amide function, which could not be hydrolyzed under acidic or basic conditions. The assigned structure and relative configuration at C(4a) and C(7a) were also confirmed by NOESY experiments (*Fig. 1*), which also facilitated the ^{1}H-NMR assignment as shown in *Table 2*.

Scheme 4



i) Phenylbis(trifluoroacetato-κO)iodine (PFAI), CH_2Cl_2, $-40°$, 3 h.

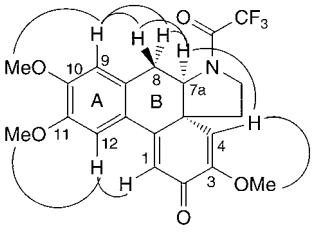


Fig. 1. *NOESY of Neospirodienone* **2a**

To study the *N*-substitution effect on this oxidative coupling reaction, the tetrahydroisoquinoline (**5d**) was modified with four other protecting groups, *i.e.*, formyl, acetyl, methylsulfonyl, and methyl, yielding **6b**–**e**, respectively. Under the same oxidative coupling conditions as those applied to **6a** (see above), **6b**–**e** gave the products shown in *Table 3* (*cf. Scheme 4*). The 3,4-dihydroisoquinoline **7** could be formed *via* a bond-cleavage mechanism since the starting materials **6** having a better leaving group lead to a better yield of **7** (46% from **6a** (CF_3CO-N) *vs.* trace from **6b** (CHO–N)). Starting from **6b** (CHO–N) or **6c** (Ac–N) gave **2b** and **2c**, respectively, in better yields than starting from **6a** (CF_3CO-N), while **6d** ($MeSO_2-N$) was decomposed during the reaction, probably due to the cleavage of the protecting group prior to the formation of the aryl radical cation.

Table 2. *^{1}H-NMR Data of (±)-Neospirodienones* **2a**–**c**. δ in ppm, J in Hz.

	2a	**2b**	**2c**
H–(C1)	6.73, 6.57 (2*s*)	6.65, 6.48 (2*s*)	6.68, 6.57 (2*s*)
H–C(4)	5.80, 5.66 (2*s*)	5.83, 5.79 (2*s*)	5.84, 5.82 (2*s*)
H–C(7a)	4.63 (*dd*)[a]), 4.46 (*t*)[b])	4.53, 4.23 (2*dd*)[a])	4.50, 4.18 (2*dd*)[a])
H_{ax}–C(8)	3.45, 3.19 (2*dd*)[c])	3.26, 3.07 (2*dd*)[c])	3.39, 3.15 (2*dd*)[c])
H_{eq}–C(8)	2.98, 2.85 (2*dd*)[d])	2.98, 2.84 (2*dd*)[d])	2.95, 2.83 (2*dd*)[d])
H–C(9)	6.63, 6.58 (2*s*)	6.64, 6.60 (2*s*)	6.62, 6.59 (2*s*)
H–C(12)	7.05, 6.96 (2*s*)	7.01, 6.93 (2*s*)	7.01, 6.95 (2*s*)
MeO–C(3)	3.70, 3.65 (2*s*)	3.72, 3.69 (2*s*)	3.68, 3.67 (2*s*)
MeO–C(10)	3.88 (*s*)	3.88 (*s*)	3.88 (*s*)
MeO–C(11)	3.88 (*s*)	3.88 (*s*)	3.88 (*s*)
CHO–N(7)	–	8.45, 8.28 (2*s*)	–

[a]) *J ca.* 3.1, 7.5. [b]) *J ca.* 7.6. [c]) *J ca.* 7.5, 17.4.d) *J ca.* 3.1, 17.4.

Table 3. *Oxidative Coupling Reactions of 1-Benzyl-1,2,3,4-tetrahydroisoquinolines* **6a**–**e** *with PFAI*

Reactant	**6a**		**6b**		**6c**	**6d**	**6e**
Product(s)	**2a**	**7**	**2b**	**7**	**2c**	**2d**	**1**
Yield[a]) [%]	42	46	67	trace	70	0	33
M.p. (Lit. m.p.) [°]	244–246 ([18]: 247–248)	–	240–242 ([16]: 243–245)	–	238–240	–	112–114 ([17]: 117–118)

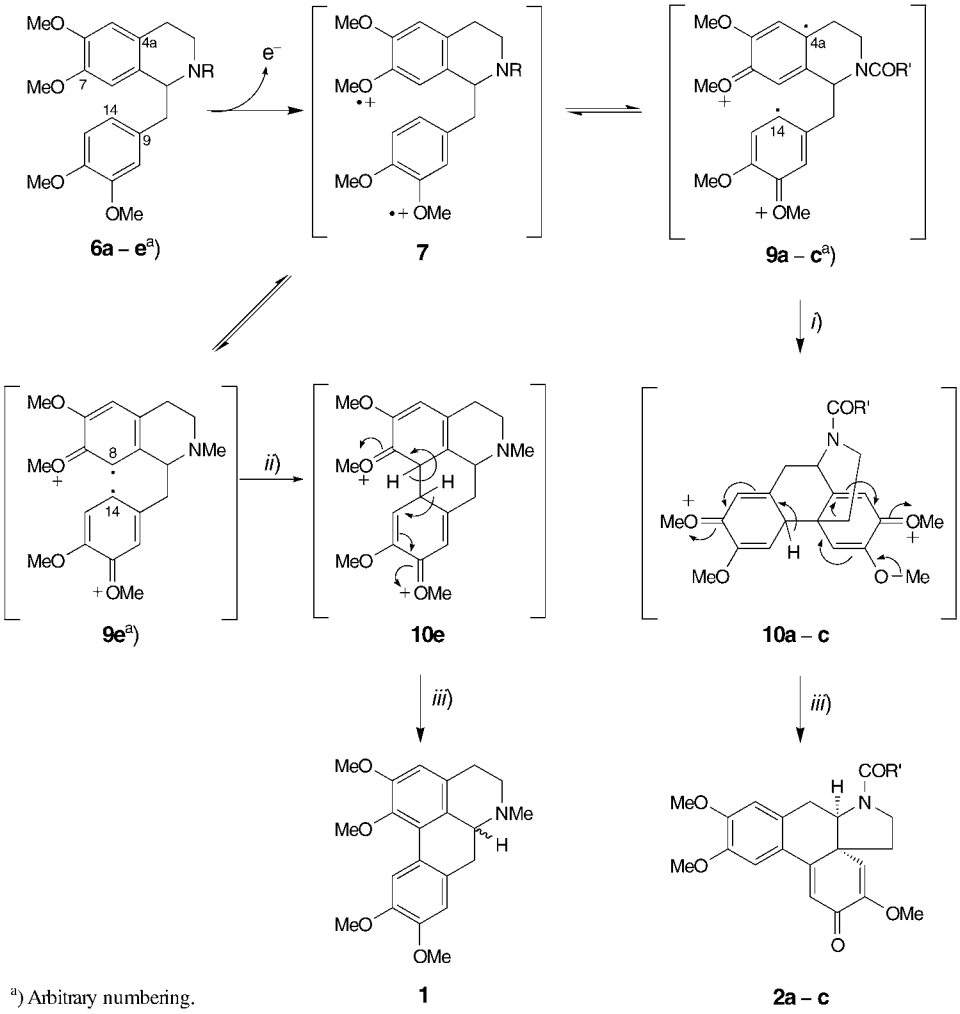
[a]) Yield of isolated product(s).

When the *N*-methyl-protected tetrahydroisoquinoline **6e**, a tertiary amine, was treated with PFAI under oxidative coupling conditions, (±)-glaucine (**1**) [17] was produced in 33% yield.

These results indicate that the inductive effect of the *N*-substituent influences the positions of the stable radical cations for oxidative coupling. Hence, a plausible mechanism is depicted in *Scheme 5* to explain the two different skeletons formed under similar condition. The bis-radical cation **8** would be first generated *via* a SET pathway, for which two different resonance forms **9** can be formulated. The *N*-acyl-substituted radical cation **9a**–**c** would afford the C(4a) and C(14) coupling products **10a**–**c** (arbitrary numbering) and then, after rearrangement and isomerization, the (±)-*N*-acylneospirodienones **2a**–**c**. The *N*-methyl-substituted radical cation **9e** would afford the C(8) and C(14) coupling product **10**, which would isomerize to (±)-glaucine (**1**).

This study provides a practical and efficient one-pot *Bischler–Napieralski* reaction for the preparation of 1-benzyl-1,2,3,4-tetrahydroisoquinoline by using excess condensation reagent (4.5 equiv. of $POCl_3$). Upon completion of this work, we found that a similar one-pot process used for the same purpose with the same reagent had been reported only once for the preparation of three selective benzyltetrahydroisoquinolines [19]. We successfully applied this one-pot reaction to the preparation of a variety of isoquinolines, such as 1-phenylisoquinolines and 1-alkylisoquinolines. By monitoring the *N*-substitution of benzyltetrahydroisoquinolines, two distinct skeletons, neospirodienone (see **2**) and aporphine (see **1**), were produced by oxidative coupling with

Scheme 5



i) *para-para* Oxidative coupling. *ii*) *ortho-para* Oxidative coupling. *iii*) Isomerization.

$[IPh(OCOCF_3)_2]$. This novel finding and the much less toxic and easier handling properties of $[IPh(OCOCF_3)_2]$ as compared to those of heavy metal containing reagents greatly favor the former reagent for the use in the synthesis of bioactive alkaloids belonging to the skeletons mentioned above.

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Experimental Part

General. TLC: silica gel, $CHCl_3$/MeOH; visualization by UV at 254 nm and by *Dragendorff*'s spray reagent. CC = Column chromatography. M.p.: in open capillaries, *Fisher-Johns* melting-point apparatus; uncorrected. FT-IR Spectra: *Jasco DIP-181-IR-Report-100* spectrophotometer; KBr pellets; $\tilde{\nu}$ in cm^{-1}. ^1H- and ^{13}C-NMR: *Bruker DPX-200* and *AMX-400*; δ in ppm, *J* in Hz. MS: *JMS-SX102A* (FAB-MS) and *Finnigan Mat-TSQ-7000* (ESI-MS) spectrometers; in *m*/*z* (rel. %).

Tetrahydroisoquinolines **5a**–**e**: *General Procedure.* To a mixture of benzeneacetic acid **4a**–**e** (10.00 mmol) and 3,4-dimethoxybenzeneethanamine (**3d**) (1.81 g, 10.00 mmol), $POCl_3$ (4 ml, 43.92 mmol) was added dropwise. After 1 h stirring at r.t., toluene (10 ml) was added and the mixture heated under reflux for 3.5 h. Then the mixture was evaporated, the residue dissolved in MeOH (5 ml), and the soln. poured into ice. The aq. phase was basified with 25% NH_4OH soln. and extracted with CH_2Cl_2 (3 × 50 ml), the combined org. phase washed with H_2O (100 ml), dried (Na_2SO_4), and evaporated, and the residue dissolved in MeOH (30 ml). To this soln., $NaBH_4$ (946 mg, 25.00 mmol) was added portionwise during 30 min while stirring. After 2.5 h, the soln. was evaporated, the residue suspended in CH_2Cl_2 (50 ml) and washed with H_2O (50 ml), the org. phase dried (Na_2SO_4), evaporated, and the residue purified by CC (Al_2O_3): **5a**–**e** (*Table 1*).

1,2,3,4-Tetrahydro-6,7-dimethoxy-1-(phenylmethyl)isoquinoline (**5a**): ^1H-NMR ($CDCl_3$, 400 MHz): 7.33–7.32 (*m*, C_6H_5); 6.57 (*s*, H–C(5)); 6.56 (*s*, H–C(8)); 4.16 (*dd*, *J* = 9.1, 4.7, H–C(1)); 3.83 (*s*, MeO–C(6)); 3.77 (*s*, MeO–C(7)); 3.21–3.15 (*m*, 2 H); 2.96–2.89 (*m*, 2 H); 2.75–2.69 (*m*, 2 H); 2.19 (br. *s*, NH). FAB-MS: 284 (80, $[M+H]^+$), 192 (100).

1-[(4-Bromophenyl)methyl]-1,2,3,4-tetrahydro-6,7-dimethoxyisoquinoline (**5b**): ^1H-NMR ($CDCl_3$, 400 MHz): 7.42 (*d*, *J* = 8.3, H–C(3′), H–C(5′)); 7.11 (*d*, *J* = 8.3, H–C(2′), H–C(6′)); 6.57 (*s*, H–C(5)); 6.49 (s, H–C(8)); 4.18 (*dd*, *J* = 8.6, 5.0, H–C(1)); 3.86 (*s*, MeO–C(6)); 3.76 (*s*, MeO–C(7)); 3.18–3.12 (*m*, 2 H); 2.99–2.93 (*m*, 2 H); 2.75–2.74 (*m*, 2 H). FAB-MS: 362 (40, $[M+H]^+$), 192 (40), 153 (100).

1,2,3,4-Tetrahydro-6,7-dimethoxy-1-[(4-methoxyphenyl)methyl]isoquinoline (**5c**): ^1H-NMR ($CDCl_3$, 400 MHz): 7.14 (*dd*, *J* = 6.6, 2.0, H–C(2′), H–C(6′)); 6.84 (*dd*, *J* = 6.6, 2.0, H–C(3′), H–(5′)); 6.57 (*s*, H–C(5)); 6.54 (*s*, H–C(8)); 4.14 (*dd*, *J* = 8.7, 5.0, H–C(1)); 3.83 (*s*, MeO–C(6)); 3.78 (*s*, MeO); 3.77 (*s*, MeO); 3.22–3.10 (*m*, 2 H); 2.97–2.90 (*m*, 2 H); 2.76–2.72 (*m*, 2 H). FAB-MS: 314 (40, $[M+H]^+$), 192 (100).

1-[(3,4-Dimethoxyphenyl)methyl]-1,2,3,4-tetrahydro-6,7-dimethoxyisoquinoline (**5d**): ^1H-NMR ($CDCl_3$, 400 MHz): 6.80 (*d*, *J* = 8.1, H–C(5′)); 6.76 (*dd*, *J* = 8.1, 1.6, H–C(6′)); 6.72 (*d*, *J* = 1.6, H–C(2′)); 6.61 (*s*, H–C(5)); 6.56 (*s*, H–C(8)); 4.12 (*dd*, *J* = 8.9, 4.4, H–C(1)); 3.84 (*s*, MeO); 3.82 (*s*, MeO); 3.81 (*s*, MeO); 3.79 (*s*, MeO); 3.18–3.12 (*m*, 2 H); 2.92–2.82 (*m*, 2 H); 2.73–2.62 (*m*, 2 H); 2.19 (br. *s*, NH). FAB-MS: 344 (80, $[M+H]^+$), 192 (80); 153 (100).

1,2,3,4-Tetrahydro-6,7-dimethoxy-1-[(4-nitrophenyl)methyl]isoquinoline (**5e**): ^1H-NMR ($CDCl_3$, 400 MHz): 8.15 (*d*, *J* = 8.8, H–C(3′), H–C(5′)); 7.41 (*d*, *J* = 8.8, H–C(2′), H–C(6′)); 6.58 (*s*, H–C(5)); 6.56 (*s*, H–C(8)); 4.23 (*dd*, *J* = 9.2, 4.4, H–C(1)); 3.85 (*s*, MeO–C(6)); 3.79 (*s*, MeO–C(7)); 3.26 (*dd*, *J* = 13.7, 4.4, H–C(9)); 3.19–3.14 (*m*, 1 H); 3.06 (*dd*, *J* = 13.7, 9.2, H–C(9)); 2.97–2.94 (*m*); 2.73–2.70 (*m*, 2 H); 2.20 (br. *s*, NH). FAB-MS: 329 (30, $[M+H]^+$), 192 (100).

Tetrahydroisoquinolines **5f**,**g**. As described for **5a**–**e**, with 3,4-dimethoxybenzeneacetic acid (**4d**) (1.96 g, 10.00 mmol) and benzenethanamines **3f**–**g** (10.00 mmol): **5f**,**g** (*Table 1*).

5-[(3,4-dimethoxyphenyl)methyl]-5,6,7,8-tetrahydro-1,3-dioxolo[4,5-g]isoquinoline (**5f**): ^1H-NMR ($CDCl_3$, 400 MHz): 6.81 (*d*, *J* = 8.1, H–C(5′)), 6.76 (*dd*, *J* = 8.1, 1.8, H–C(6′)), 6.73 (*d*, *J* = 1.8, H–C(2′)), 6.68 (*s*, H–C(9)); 6.54 (*s*, H–C(4)), 5.88 (*s*, OCH_2O); 4.08 (*dd*, *J* = 9.5, 3.8, H–C(5)); 3.87 (*s*, MeO); 3.85 (*s*, MeO), 3.15–3.10 (*m*, 2 H); 2.88–2.71 (*m*, 2 H); 2.70–2.66 (*m*, 2 H); 2.23 (br. *s*, NH). FAB-MS: 328 (70, $[M+H]^+$), 176 (100).

1-[(3,4-Dimethoxyphenyl)methyl]-1,2,3,4-tetrahydro-5,6,7-trimethoxyisoquinoline (**5g**): ^1H-NMR ($CDCl_3$, 400 MHz): 6.81 (*d*, *J* = 8.1, H–C(5′)); 6.79 (*dd*, *J* = 8.1, 1.6, H–C(6′)); 6.75 (*d*, *J* = 1.6, H–C(2′)); 6.39 (*s*, H–C(5)); 4.24 (*dd*, *J* = 9.7, 2.7, H–C(1)); 3.98 (*s*, MeO), 3.84–3.83 (*s*, 3 MeO); 3.82 (*s*, MeO), 3.18–3.15 (*m*); 3.05 (*dd*, *J* = 13.8, 2.7, 1 H, $(MeO)_2C_6H_3CH_2$); 2.95–2.90 (*m*); 2.87 (*dd*, *J* = 13.8, 9.7, 1 H, $(MeO)_2C_6H_3CH_2$); 2.80–2.76 (*m*), 2.60–2.54 (*m*), 2.72 (br. *s*, NH). FAB-MS: 374 (80, $[M+H]^+$), 222 (100).

Oxidative Coupling of **6a**–**e** *with PFAI. General Procedure.* To a soln. of **6a**–**e** (0.26 mmol) in CH_2Cl_2 (10 ml), a soln. of PFAI (125 mg, 0.29 mmol) and $BF_3 \cdot Et_2O$ (0.18 ml, 0.68 mmol) in CH_2Cl_2 (10 ml) was added dropwise at −40°, and the mixture was stirred for 3 h. Then sat. aq. $NaHCO_3$ soln. was added, the aq. phase extracted with CH_2Cl_2 (25 ml × 3), the extract dried (Na_2SO_4) and evaporated, and the residue purified by CC (0–50% $CHCl_3$/hexane): pure **2a**–**c** (*Table 3*).

*(±)-6,7,7a,8-Tetrahydro-3,10,11-trimethoxy-7-(trifluoroacetyl)-dibenz[*d,f*]indol-2(5*H*)-one* (**2a**). FT-IR: 2922*s*, 1684*s*, 1656*s*, 1636*s*, 1590*s*, 1219*s*, 1145*s*. ^{1}H-NMR ($CDCl_3$, 400 MHz): *Table 2*. ^{13}C-NMR ($CDCl_3$, 100 MHz); 180.7, 180.6 (2*s*); 156.7, 154.4 (2*s*); 152.1, 151.8 (2*s*); 151.7, 151.3 (2*s*); 148.7, 148.6 (2*s*); 127.4, 126.9 (2*s*); 125.2, 122.6 (2*s*); 123.9, 123.7 (2*d*); 116.3, 114.3 (2*d*); 111.0, 110.4 (2*d*); 107.9, 107.4 (2*d*); 60.6, 60.5 (2*q*); 56.1, 55.9 (2*q*); 55.2, 55.1 (2*q*); 48.1, 47.4 (2*s*); 45.0, 44.9 (2*t*); 41.2, 36.2 (2*t*); 33.3, 31.7 (2*t*). FAB-HR-MS: 424.1367 ($[M+H]^+$, $C_{21}H_{21}O_5NF_3^+$; calc. 424.1372).

3,4-Dihydro-6,7-dimethoxyisoquinoline (**7**): ^{1}H-NMR ($CDCl_3$, 400 MHz): 8.14 (*s*, H–C(1)); 6.81 (*s*, H–C(8)); 6.56 (*s*, H–C(5)); 6.49 (*s*, H–C(8)); 3.90 (*s*, MeO–C(7)); 3.88 (s, MeO–C(6)); 3.72–3.71 (*m*, 2 H–C(3)); 2.68 (*t*, $J=8.0$, 2 H–C(4)).

*(±)-5,6,7a,8-Tetrahydro-3,10,11-trimethoxy-2-oxodibenz[*d,f*]indole-7(2*H*)-carbaldehyde* (**2b**). FT-IR: 2938*s*, 1665*s*, 1628*s*, 1588*s*, 1511*s*, 1217*s*, 1180*s*. ^{1}H-NMR ($CDCl_3$, 400 MHz): *Table 2*. ^{13}C-NMR ($CDCl_3$, 100 MHz) 181.0, 180.9 (2*s*); 161.0, 160.7 (2*d*); 158.1, 156.2 (2*s*); 151.9, 151.5 (2*s*); 151.3, 150.9 (2*s*); 148.8, 148.6 (2*s*); 128.3, 127.1 (2*s*); 126.3, 124.3 (2*s*); 123.8, 123.3 (2*d*); 118.0, 116.1 (2*d*); 111.3, 110.8 (2*d*); 108.1, 108.0 (2*d*); 59.5, 57.1 (2*q*); 56.2, 56.1 (2*q*); 55.3, 55.2 (2*q*); 49.4, 48.1 (2*s*); 45.1, 41.8 (2*t*); 41.1, 38.8 (2*t*); 35.1, 32.2 (2*t*). FAB-HR-MS: 356.1509 ($[M+H]^+$, $C_{20}H_{22}O_5N^+$; calc. 356.1498).

*(±)-7-Acetyl-6,7,7a,8-tetrahydro-3,10,11-trimethoxy-dibenz[*d,f*]indol-2(5*H*)-one* (**2c**). FT-IR: 2935*s*, 1630*s*, 1587*s*, 1514*s*, 1416*s*, 1249*s*, 1219*s*. ^{1}H-NMR ($CDCl_3$, 400 MHz): *Table 2*. ^{13}C-NMR ($CDCl_3$, 100 MHz): 181.0, 180.8 (2*s*); 169.9, 169.3 (2*s*); 157.6, 155.7 (2*s*); 151.9, 151.5 (2*s*); 151.4, 150.9 (2*s*); 148.6, 148.3 (2*s*); 128.4, 127.0 (2*s*); 125.3 (*s*); 123.6, 123.3 (2*d*); 117.3, 116.1 (2*d*); 111.1, 110.6 (2*d*); 108.1, 107.7 (2*d*); 60.2, 58.2 (2*q*); 56.0, 55.9 (2*q*); 55.3, 55.1 (2*q*); 48.4, 48.1 (2*s*); 45.8, 43.7 (2*t*); 41.0, 38.0 (2*t*); 33.8, 32.6 (2*t*); 22.9, 22.4 (2*q*). FAB-HR-MS: 370.1654 ($[M+H]^+$, $C_{21}H_{24}O_5N^+$; calc. 370.1655).

(±)-Glaucine (*=(±)-5,6,6a,7-tetrahydro-1,2,9,10-tetramethoxy-6-methyl-4*H*-dibenzo[*de,g*]quinoline;* **1**). ^{1}H-NMR ($CDCl_3$, 400 MHz): 8.06 (*s*, H–C(11)); 6.75 (*s*, H–C(8)); 6.56 (*s*, H–C(3)); 3.91 (*s*, MeO–C(9)); 3.88 (*s*, MeO–C(10)); 3.86 (*s*, MeO–C(2)); 3.64 (*s*, MeO–C(1)), 2.53 (*s*, MeN). FAB-MS: 356 (100, $[M+H]^+$), 154 (45), 136 (30).

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