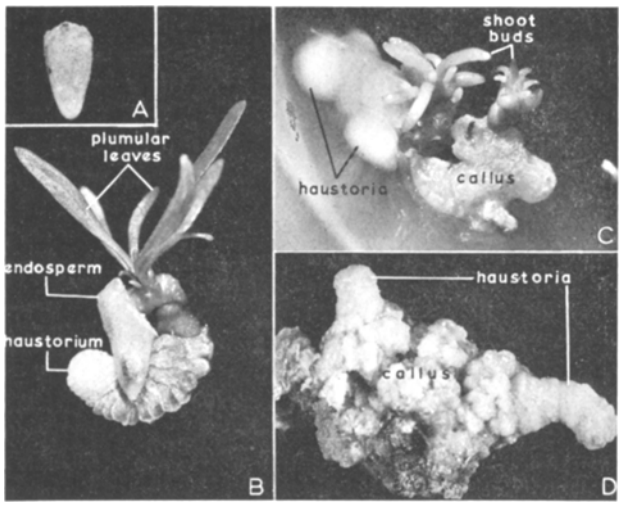
proliferated endosperm. If these were excised and planted on WM + 400 ppm CH + 1 ppm IAA + 1 ppm kinetin, they proliferated into a callus and subsequently differentiated shoots and haustoria (Figure D).



(A) 'Seed' (endosperm with enclosed embryo) at culture. ×2.5. (B) 9-week-old seedling on WM + 400 ppm CH; note the worm-like haustorium and several plumular leaves. Endosperm is on left. ×2.5. (C) 20-week-old seed culture on WM + 400 ppm CH + 1 ppm IAA, showing embryonal callus which has differentiated shoot buds and haustoria. × 2. (D) 15-week-old culture of shoot buds of endospermic origin, on WM + CH + IAA + kinetin. The callused bud has differentiated haustoria. × 2.5.

The haustoria, either from the embryo or the endosperm, were worm-like. Anatomically, they were comparable to the haustoria formed inside the host tissue in vivo, and showed a glandular epidermis, characteristic collapsed layers, and centrally arranged vascular bundles.

Thus, seeds of the parasite *Scurrula pulverulenta* can germinate on a simple nutrient medium and the differentiation of haustoria is not at all host-dependent. It is concluded that in this plant the cells of the endosperm and embryo have the inherent potentiality for the development of haustoria but this must be evoked by suitable chemical milieu[6].

Zusammenfassung. Die Samen von *Scurrula pulverulenta*, einem Baumparasiten, keimen auf einfachen Nährböden. Aus den embryonalen und endospermalen Geweben entwickeln sich in den In-vitro-Kulturen, auch bei Abwesenheit von Wirtsgewebe, Haustorien.

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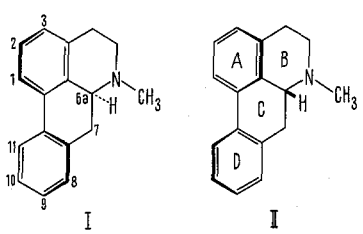
STUDIORUM PROGRESSUS

The Relationship Between the Ring D-Substituents and the Absolute Configuration for the Aporphine Alkaloids

All aporphines possess a permanently twisted biphenyl system, and the sign of the specific rotation at 589 nm is usually a good criterion for the absolute configuration[1,2]. If an aporphine is dextrorotatory its absolute configuration is as in I, while if it is levorotatory the absolute configuration is represented by expression II. Positions 1 and 2 are always substituted, while substituents may also be present at C-3, 7, 8, 9, 10, or 11.



I II

In 1962, one of us made some tentative generalizations relating the position of the substituents in ring D of the naturally occurring aporphines to the absolute configurations of the molecules[3]. Since this time a large number of new aporphines have been isolated, so that a reconsideration of this relationship is warranted.

1, 2, 9, 10-Substituted aporphines. C-1, 2, 9, 10-substituted aporphines are generally dextrorotatory, and hence of absolute configuration I. Approximately a dozen such alkaloids were known in 1962, and this number has now more than doubled. Table I lists the names, substituents, and specific rotations for the aporphines belonging to this group.

The only exception appears to be the rarely occurring base phanostenine which exhibits $[\alpha]_D$ −36.7° ($CHCl_3$). (±)-Isoboldine has been found together with (+)-isoboldine in *Glaucium* spp.[4]. Aporphines are not usually found in a racemic form, and it is probable that the racemic isoboldine was formed in the plant by oxidation of (+)-isoboldine to the corresponding immonium salt or eneamine, which was then reduced non-stereospecifically back to isoboldine.

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1,2,10,11-Substituted aporphines. Aporphines substituted at C-1, 2, 10, 11 are dextrorotatory, and therefore of type I. More than 2 dozen of these aporphines are presently known, and those for whom specific rotations have been recorded are listed in Table II.

The only exception to the trend toward dextrorotation is the alkaloid laurepukine (Table II), $[\alpha]_D$ $-222°$ ($CHCl_3$), isolated in 1931 from *Laurelia nova-zelandiae* (Lauraceae). Interestingly enough, laurepukine is also the only naturally occurring aporphine which possesses an *ortho* diphenolic system. A recent careful reinvestigation of the alkaloids of *L. nova-zelandiae* yielded no laurepukine[5].

Specific rotation measurements offer a simple way of differentiating between C-1, 2, 9, 10 and C-1, 2, 10, 11 substituted aporphines. Perusal of Tables I and II reveals that the 1, 2, 9, 10 series exhibits rotations of $+119°$ or less, whereas the 1, 2, 10, 11 substituted aporphines show values of $+139°$ or more.

Aporphines monosubstituted in ring D. More than 12 aporphines are known that are monosubstituted in ring D (Table III). The trend is for these compounds to be levorotatory and of type II. There are, however, 4 interesting exceptions, namely (+)-mecambroline, isothebaine, nuciferoline, and sparsiflorine, all of which are dextrorotatory.

The alkaloid mecambroline when isolated from *Meconopsis cambrica* Vig. (Papaveraceae) is dextrorotatory, but is levorotatory when originating from *Laurelia novaezelandiae* (Lauraceae). Similarly, isothebaine, which is known only in the dextrorotatory form is obtained from the Papaveraceae species *Papaver orientale* and *P. bracteatum*; and nuciferoline occurs in *P. caucasicum*. It appears, therefore, that aporphines originating from the family Papaveraceae are dextrorotatory, and of type I. This trend will become even more evident when the aporphines unsubstituted in ring D are considered in the next section.

The alkaloid sparsiflorine has been reported to be dextrorotatory. It is obtained not from a Papaveraceae, but from a member of the Euphorbiaceae, *Croton sparsiflorus* Morung. The free base is unstable, so that the rotation was obtained on the hydrochloride salt, $[\alpha]_D$ $+43°$ (H_2O). This is only a relatively small positive rotation, and until an optical rotatory dispersion curve is obtained no firm conclusion can be made regarding the absolute configuration of sparsiflorine.

Aporphines unsubstituted in ring D. Those aporphines unsubstituted in ring D obtained from members of the Papaveraceae family are dextrorotatory, while the others are generally levorotatory (Table IV). For example, (+)-nuciferine as well as (+)-roemerine are obtained from *Papaver* spp. But nuciferine from the non-papaveraceous *Nelumbo nucifera* and *N. lutea* is levorotatory, and similarly roemerine from the non-papaveraceous *Cryptocaria angulata*, *Neolitsea sericea*, and *Nelumbo nucifera* is levorotatory.

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Table I. Aporphines substituted at C-1, 2, 9, 10

Aporphine	Substituent positions							$[\alpha]_D$	References
	1	*2*	*3*	*N*	*8*	*9*	*10*		
Neolitsine	O–CH_2–O			CH_3		O–CH_2–O		+ 56.5° ($CHCl_3$)	6
Cassyfiline (cassythine)	O–CH_2–O		OCH_3	H		OH	OCH_3	+ 24° ($CHCl_3$)	6
Ocoteine	O–CH_2–O		OCH_3	CH_3		OCH_3	OCH_3	+ 33.3° ($CHCl_3$)	7
Cassythidine	O–CH_2–O		OCH_3	H		O–CH_2–O		+ 15° ($CHCl_3$)	6
Ocopodine	O–CH_2–O			CH_3	OCH_3	OCH_3	OCH_3	+ 87° (EtOH)	8
Actinodaphnine	O–CH_2–O			H		OH	OCH_3	+ 39° (EtOH)	7
N-Methylactinodaphnine (cassythicine)	O–CH_2–O			CH_3		OH	OCH_3	+ 59° (EtOH)	6
Dicentrine	O–CH_2–O			CH_3		OCH_3	OCH_3	+ 56° (EtOH)	7
Phanostenine	O–CH_2–O			CH_3		OCH_3	OH	− 36.7° ($CHCl_3$)	7
Quaternary from *F. tinguassoiba* chloride	OH	OCH_3		$(CH_3)_2$		OCH_3	OCH_3	+ 30.2° (H_2O)	7
Isoboldine	OH	OCH_3		CH_3		OH	OCH_3	+ 41.2° (EtOH)	6
Laurelliptine	OH	OCH_3		H		OH	OCH_3	+ 47° (EtOH)	7
Thaliporphine (thalicmidine)	OH	OCH_3		CH_3		OCH_3	OCH_3	+110° (EtOH)	9
Bracteoline	OH	OCH_3		CH_3		OH	OCH_3	+ 35° ($CHCl_3$)	10
Wilsonerine	OH	OCH_3		H		OCH_3	OCH_3	+ 56° (MeOH)	11
Laurifoline chloride	OH	OCH_3		$(CH_3)_2$		OH	OCH_3	+ 26.3° (H_2O)	7
Domesticine	OH	OCH_3		CH_3		O–CH_2–O		+ 60.5°	7
Nordomesticine	OH	OCH_3		H		O–CH_2–O		+ 31.5° ($CHCl_3$)	12
Laurolitsine	OCH_3	OH		H		OH	OCH_3	+102.5° (EtOH)	7
Boldine	OCH_3	OH		CH_3		OH	OCH_3	+112° (EtOH)	7
Xanthoplanine iodide hemihydrate	OCH_3	OCH_3		$(CH_3)_2$		OH	OCH_3	+ 71° (EtOH)	7
Nantenine	OCH_3	OCH_3		CH_3		O–CH_2–O		+101° ($CHCl_3$)	7
Nornantenine	OCH_3	OCH_3		H		O–CH_2–O		+ 85° ($CHCl_3$)	13
N-Methyllaurotetanine	OCH_3	OCH_3		CH_3		OH	OCH_3	+ 88° ($CHCl_3$)	13
Laurotetanine	OCH_3	OCH_3		H		OH	OCH_3	+ 98° (EtOH)	7
Glaucine	OCH_3	OCH_3		CH_3		OCH_3	OCH_3	+119° ($CHCl_3$)	7
Cocsarmine iodide trihydrate	OCH_3	OCH_3		$(CH_3)_2$		OCH_3	OH	+ 27.9° (EtOH)	7

Table II. Aporphines substituted at C-1, 2, 10, 11

Aporphine	Substituted positions						$[\alpha]_D$	References
	1	*2*	*3*	*N*	*10*	*11*		
Launobine	O–CH_2–O			H	OCH_3	OH	+192.7° ($CHCl_3$)	6
Nandigerine (hernangerine)	O–CH_2–O			H	OH	OCH_3	+248° (EtOH)	6
N-Methylnandigerine hydrobromide	O–CH_2–O			CH_3	OH	OCH_3	+170° (H_2O)	6
Ovigerine (hernovine)	O–CH_2–O			H	O–CH_2–O		+217° ($CHCl_3$)	6
N-Methylovigerine	O–CH_2–O			CH_3	O–CH_2–O		+222° ($CHCl_3$)	6
Bulbocapnine	O–CH_2–O			CH_3	OCH_3	OH	+237° ($CHCl_3$)	7
Hernandine	O–CH_2–O		OCH_3	H	OCH_3	OCH_3	+347°	14
N-Methylcorydinium iodide	OH	OCH_3		$(CH_3)_2$	OCH_3	OCH_3	+168.6° (EtOH-H_2O)	7
Magnoflorine	OH	OCH_3		$(CH_3)_2$	OCH_3	OH	+220° (MeOH)	7
Corydine	OH	OCH_3		CH_3	OCH_3	OCH_3	+205° ($CHCl_3$)	7
Corytuberine	OH	OCH_3	CH_3	OCH_3	OCH_3	OH	+282.5° (EtOH)	7
Hernovine	OCH_3	OH		H	OH	OCH_3	+142° (Py.)	6
Lindcarpine	OCH_3	OH		H	OCH_3	OH	+166° (EtOH)	15
N-Methyllindcarpine	OCH_3	OH		CH_3	OCH_3	OH	+160° ($CHCl_3$)	15
N-Methylhernovine hydrochloride	OCH_3	OH		CH_3	OH	OCH_3	+209° (MeOH)	16
10-*O*-Methylhernovine	OCH_3	OH		H	OCH_3	OCH_3	+188° (EtOH)	16
N-Methyl-10-methylhernovine	OCH_3	OH		CH_3	OCH_3	OCH_3	+139° (MeOH)	16
Catalpifoline	OCH_3	OCH_3		H	OCH_3	OCH_3	+220° (EtOH)	6
Isocorydine	OCH_3	OCH_3		CH_3	OCH_3	OH	+202° (MeOH)	7
Oconovine	OCH_3	OCH_3	OCH_3	CH_3	OCH_3	OH	+156° ($CHCl_3$)	8
Ocokryptine	OCH_3	O–CH_2–O		CH_3	OCH_3	OH	+164° ($CHCl_3$)	8
Norisocorydine	OCH_3	OCH_3		H	OCH_3	OH	+158.5° (EtOH)	7
N-Methylcorydinium chloride	OCH_3	OCH_3		$(CH_3)_2$	OCH_3	OH	+168.6° (H_2O)	6
Laurepukine	OH	OH		CH_3	O–CH_2–O		−222° ($CHCl_3$)	7

Table III. Aporphines monosubstituted in ring D

Aporphine	Substituent positions							$[\alpha]_D$	References
	1	*2*	*N*	*8*	*9*	*10*	*11*		
Sparsiflorine hydrochloride	OH	OCH_3	H			OH		+ 43° (H_2O)	6
1,10-Dihydroxy-2-methoxyaporphine	OH	OCH_3	CH_3			OH		− 35° ($CHCl_3$)	6
(+)-Mecambroline	O–CH_2–O		CH_3			OH		+ 76° ($CHCl_3$)	6
(−)-Mecambroline	O–CH_2–O		CH_3			OH		− 77° ($CHCl_3$)	5
Tuduranine	OCH_3	OCH_3	H			OH		−127.5° (EtOH)	7
Michepressine iodide	O–CH_2–O		$(CH_3)_2$			OH		−130.8° (MeOH)	7
Laureline	O–CH_2–O		CH_3			OCH_3		− 98.5° (EtOH)	7
Anolobine	O–CH_2–O		H		OH			− 22.5° ($CHCl_3$-MeOH)	7
Xylopine	O–CH_2–O		H		OCH_3			− 23.4° (MeOH)	7
Pukateine	O–CH_2–O		CH_3				OH	−220° (EhOH)	7
Pukateine methyl ether	O–CH_2–O		CH_3				OCH_3	−293.4° ($CHCl_3$)	5
Isothebaine	OH	OCH_3	CH_3				OCH_3	+285.1° (EtOH)	7
Stephanine	O–CH_2–O		CH_3	OCH_3				− 92.5° ($CHCl_3$)	7
Nuciferoline	OCH_3	OCH_3	CH_3			OH		+154° (EtOH)	17

Table IV. Aporphines unsubstituted in ring D

Aporphine	Substituent positions						$[\alpha]_D$	References
	1	*2*	*3*	*N*	*7*			
(−)-Nuciferine	OCH_3	OCH_3		CH_3			−157.5° (EtOH)	7
(+)-Nuciferine	OCH_3	OCH_3		CH_3			+165° (EtOH)	18
Nornuciferine	OCH_3	OCH_3		H			−145° (EtOH)	7
Anonaine	O–CH_2–O			H			− 52° ($CHCl_3$)	7
(−)-Roemerine	O–CH_2–O			CH_3			− 72.5° (EtOH)	7
(+)-Roemerine (aporeine)	O–CH_2–O			CH_3			+ 75° (EtOH)	18
Ushinsunine	O–CH_2–O			CH_3	OH		−117° ($CHCl_3$)	7
Norushinsunine (michelalbine)	O–CH_2–O			H	OH		−105.2° ($CHCl_3$)	7
Guatterine	O–CH_2–O		OCH_3	CH_3	OH		− 57.1° ($CHCl_3$)	6
1-Methoxy-2-hydroxyaporphine	OCH_3	OH		CH_3			−265° ($CHCl_3$)	7
Asimilobine	OCH_3	OH		H			−213° ($CHCl_3$)	6
Caaverine	OH	OCH_3		H			− 89° (MeOH)	6

From Table IV it can also be seen that when the C-1 substituent is a methoxy group, the magnitude of the specific rotation is greater than 145°. But if a hydroxy or a methylenedioxy group is involved at C-1, the magnitude is less than 120°.

The above generalizations should be of use in the structural elucidation of new aporphine alkaloids. More importantly, they point to certain biogenetic traits in the formation of these natural products, and specifically to a relationship between structure, absolute configuration, and plant family.

Proaporphines have been clearly demonstrated to be the precursors of at least some of the aporphine alkaloids, and the trends described above may be traced back to some extent into the proaporphine series[19]. However, an insufficient number of proaporphines have been isolated so far from different sources to allow for firm generalizations.

In conclusion then, the following summary statement can be made: Naturally occurring aporphines are usually dextrorotatory and of type I. But those aporphines monosubstituted or unsubstituted in ring D, and which do not originate from the plant family Papaveraceae, generally are levorototatory and of type II. The magnitude of the specific rotation may also be useful in elucidating the substitution pattern on the aporphine skeleton[20].

Résumé. Les alcaloïdes aporphiniques substitués en positions 1, 2, 9, 10 on en 1, 2, 10, 11 sont dextrorotatoires et du type I. Mais les aporphines monosubstituées ou non substituées dans le cycle D, et qui ne parviennent pas de la famille Papaveraceae, sont généralement lévorotatoires et du genre II.

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Separate and Simultaneous Effects of Ethanol, Hypertonic Saline and Insulin on the Function of the Subcommissural Organ

The subcommissural organ (SCO) is made up of a group of ependymal cells situated above the orifice of the aqueductus cerebri. Morphological studies, including electronmicroscopical examination, have disclosed the typical characteristics of secretory cells[1]. The secretion consists of a mucopolysaccharide protein-complex which greatly resembles the neurosecretory materials of the posterior hypophysis[2]. Both secretions are revealed almost specifically by aldehyde-fuchsin staining, applied in most histochemical studies.

SCO has good humoral and neural connections: it is bathed in the cerebrospinal fluid, and it has a rich vasculature. Moreover, fibres of the autonomic nervous system are demonstrable between the secretory cells[1,3,4].

In the main, study of possible functions has proceeded by morphological means, since the SCO is small, the amount of the secretion is minimal, and under ordinary circumstances the anatomic location makes it difficult to reach. Classical ablation and extraction studies have been made, although to date the results are divergent. However, some evidence has been elicited which favours the concept that this organ might participate in regulation of the electrolyte balance[5–8].

A number of substances induce cytological changes in the cells, and these have been 'photographed' at certain moments during the experiments. For instance, hypertonic saline given for many days increases the amount of secretion[9], excessive water intake enlarges the nuclei of the SCO cells[10] and a diet deficient in sodium exercises the opposite effect, diminution of the nuclear volumes[11].

With respect to the findings mentioned it has been suggested that the cytological changes in the subcommissural cells and the electrolyte imbalances are in causal relationship, and can even be interpreted as a proof of the regulatory function exerted by SCO on the electrolyte metabolism[12].

The ingestion of ethanol inhibits liberation of the antidiuretic hormone (ADH), depresses the function of the supraoptic and paraventricular nuclei[13], and is moreover followed by plasma hyperkalemia and hyponatremia[14].

The administration of insulin leads to hypokalemia and disappearance of the aldehyde-fuchsin positive secretion in SCO within 2 weeks[15].

It is thus apparent that the substances mentioned either have, or are likely to have, an effect upon the subcommissural cells. Since they influence the electrolyte status in opposite and different ways, a clearer picture

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