QUATERNARY ALKALOIDS OF AN *Eschscholtzia* SPECIES (*E. oregana* GREENE?)*

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Dedicated to Professor F. Šantavý on the occasion of his 60th birthday.

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In addition to escholamine, californidine and four further quaternary alkaloids, namely, escholamidine, (—)-α-stylopine methohydroxide, alkaloid ES 1, and alkaloid ES 2 were isolated from an *Eschscholtzia* species (*E. oregana* GREENE?). The constitution of escholamidine was inferred and properties of (—)-stylopine metho salts diastereoisomeric α- and β-forms were described. The α-form was also found in *E. californica* CHAM., *Argemone ochroleuca* SWEET, and *A. platyceras* LINK et OTTO.

Some years ago[1], we have examined the alkaloids of an *Eschscholtzia* species from the section *Stenocraspedontae* FEDDE (probably *E. oregana* GREENE). A papaverine type quaternary base named escholamine has been isolated as the principal alkaloid and the constitution *Ia* (*X* is an anion) has been inferred. Recently, this constitution has been confirmed by synthesis[2]. Our attention has been now paid to minor quaternary alkaloids, the presence of which has been observed earlier[1]. Systematic work-up of the quaternary portion remaining after separation of escholamine iodide (*Ia*, X = I) led to isolation of five additional alkaloids in the form of iodides or perchlorates. One of them was identical with californidine[3] (*II*, X = is an anion) which is the principal alkaloid of upper-earth parts of three species of the genus *Eschscholtzia*[3,4] from the section *Eurycraspedontae* FEDDE. In the investigated species *Eschscholtzia oregana* GREENE (?), only minute amounts of californidine are present. The other four alkaloids have not been so far reported in the literature.

The most abundant (next to escholamine) quaternary alkaloid was isolated as iodide and given the name escholamidine. For this alkaloid the structure *Ib* (X is an anion) was inferred from the following data. The escholamidine cation exhibits the brutto formula $C_{19}H_{18}NO_4^{(+)}$ and is closely related to escholamine (except for the phenolic character), as shown by ultraviolet spectra. According to the infrared spec-

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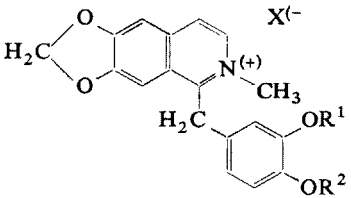
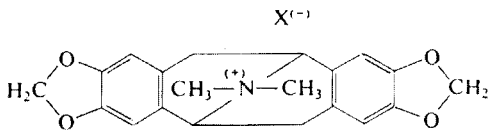
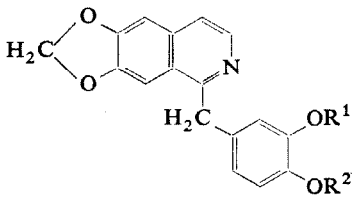
trum (in nujol), there is present an OH group (3390 and 3050 cm^{-1}), an aromatic nucleus or C=N bonds (1605–1500 cm^{-1}), a O_2CH_2 group (945 cm^{-1}), a 1,2,4,5-tetrasubstituted benzene ring (900, 875, and 855 cm^{-1}), and a 1,2,4-trisubstituted benzene ring (835 and 810 cm^{-1}). In the course of the mass spectrum measurement during evaporation in the ionic source, escholamidine iodide (*Ib*, X = I) undergoes pyro-



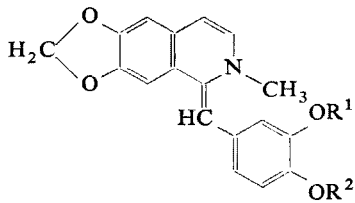
Ia, $R^1 + R^2 = CH_2$
Ib, $R^1 = CH_3$, $R^2 = H$



II



IIIa, $R^1 + R^2 = CH_2$
IIIb, $R^1 = CH_3$, $R^2 = H$

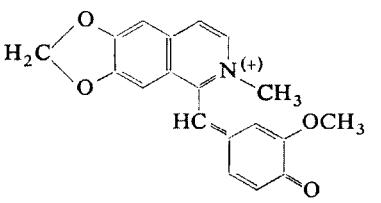


IVa, $R^1 + R^2 = CH_2$
IVb, $R^1 = CH_3$, $R^2 = H$

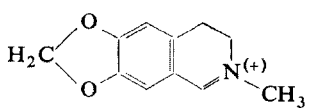
lysis (in accordance with the ammonium salt character) with the formation of the tertiary base *IIIb*, $C_{18}H_{15}NO_4$ of M^+ 309·0989 (calculated, 309·1001) and the methine *IVb* of M^+ 323. From the both molecular ions, only the hydrogen atom is split off to a greater extent. The behaviour of escholamine iodide (*Ia*, X = I) in the course of the mass spectrum measurement is similar. In the case of escholamidine methine *IVb*, the M−1 ions exhibit a considerably higher abundance (M−1/M = 1·48) than with the escholamine methine *IVa* (M−1/M = 0·59). It may be assumed in accordance with results of measurements of escholamidine iodide labelled in the ionic source with [O—^{2}H]ethanol that the above mentioned hydrogen atom originates to a great extent from the phenolic hydroxylic function in the case of the methine *IVb*; the corresponding ion is formulated by the structure *a*. On the basis of this finding we prefer the structure *Ib* for escholamidine iodide to the alternative 3-hydroxy-4-methoxy formulation.

Reduction of escholamidine iodide afforded a tetrahydro derivative, the properties of which were in accordance with those of a tertiary base. The ultraviolet spectrum was indicative of a benzyltetrahydroisoquinoline derivative. The presence of an OH

group (3540 cm^{-1}), an aromatic ring (1595–1445 cm^{-1}), and an O_2CH_2 group (945 cm^{-1}) was suggested by the infrared spectrum. The mass spectrum of tetrahydroescholamidine contains insignificant peak of M−1 ions at the mass 326. Similarly to other benzyltetrahydroisoquinoline alkaloids[5], most ionic current is concentrated in the dihydroisoquinolinium ion b of the mass 190. The complementary benzyl fragment manifests itself by a small peak at the mass 137.



a



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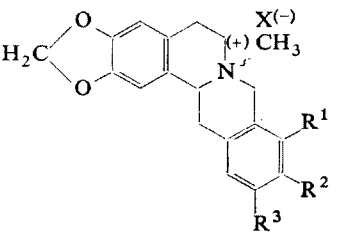

Va, $R^1 + R^2 = OCH_2O$, $R^3 = H$
Vb, $R^1 = H$, $R^2 + R^3 = OCH_2O$

The brutto formula of the further alkaloid isolated in the form of a crystalline perchlorate was $C_{20}H_{20}NO_4^{(+)}$. The mass spectrum of the iodide was identical with that of stylopine methiodide *Va* (M^+ 323, 322, 174, 148) (ref.[6,7]) but notwithstanding, the two substances are not identical. The identity with tetrahydropseudocoptisine methiodide *Vb* (prepared for the purpose of comparison from pseudocoptisine iodide[8]) could also be excluded. It has been finally found that the above *Eschscholtzia* sp. alkaloid represents the second hitherto unreported diastereoisomeric form of (−)-stylopine methohydroxide. By analogy with the conventional designation of diastereoisomeric tetrahydroprotoberberine metho salts, the present diastereoisomer may be designated as the α-form while the known and reported[6,9,10] specimen of stylopine methiodide or methoperchlorate constitutes the more stable and the higher-melting β-form. In addition to the β-form iodide which is obtained by methylation of (−)-stylopine with methyl iodide as the principal product (yield, more than 90%), we have now succeeded in isolating a small amount of the α-form iodide identical according to m.p. and mixed m.p. determination, optical rotation, UV and IR spectra, and R_F values with the iodide of the naturally occurring *Eschscholtzia* sp. alkaloid and also identical with one of the minor alkaloids isolated from the root of *E. californica* CHAM. (*cf.*[11]).

In contrast to metho salts of other tetrahydroprotoberberines, the α- and β-forms of (−)-stylopine metho salts differ only poorly from each other in their melting point and optical rotation values. The UV spectra of both forms are identical while the IR spectra exhibit significant differences particularly in the 800 to 950 cm^{-1} region. The unequivocal differentiation and identification of the two forms was finally made possible by the observation that the diastereoisomers markedly differed by their R_F values in paper chromatography. Similar differences have also been encountered with other tetrahydroprotoberberine metho salts. Paper chromatography thus represents the single reliable criterion of the diastereoisomeric purity in this field of chemistry. On the other hand, it is not possible to differentiate between the diastereoisomers by means of thin-layer chromatography in spite of numerous developing systems attempted; only the α- and β-forms of stylopine metho salts are somewhat different in this respect.

Paper chromatography has been now used in reinvestigations of (−)-stylopine metho salts, isolated earlier from some plants. *Glaucium corniculatum* CURT.[6] contains exclusively the β-form while in the *Argemone* species such as *A. ochroleuca* SWEET[9], *A. platyceras* LINK et OTTO[10], and *A. mexicana* L. (ref.[12]), the α-form farly predominates. The specimens described in refs.[9,10] were the β-forms because the much more readily soluble salts of the α-forms remained in mother liquors. The (−)-stylopine metho salt isolated by Preininger and coworkers[7] from *Papaver rhoeas* L. was shown to represent the pure β-form; the same form has been recently isolated also from *P. syriacum* BOISS. et BLANCHE[13].

The trace amounts of the remaining two quaternary alkaloids designated as ES 1 and ES 2 and isolated as perchlorates allowed characterisation by melting point data, R_F values, UV spectrum, and colour reactions. None of the constants obtained corresponded to those of the hitherto known *Papaveraceae* alkaloids.

From the "non-quaternary" portion of bases, there were isolated all the alkaloids reported in the earlier paper[1]. Moreover, thin-layer chromatography indicated the presence of a greater number of additional alkaloids; two of them are obviously identical with corydine and scoulerine.

EXPERIMENTAL

Melting points (uncorrected) were determined in a capillary or on a heated microscope stage (Kofler block). Mass spectra were measured on an AEI-MS 902 mass spectrometer; IR spectra were taken on an Infrascan Hilger and Watts apparatus; and the UV spectra were recorded on a Unicam SP 500 apparatus (in methanol). Thin-layer chromatography was performed either on 5 : 1 silica gel G Merck and gypsum (as binder) in the solvent systems S_1, cyclohexane–diethylamine (9 : 1), S_2, cyclohexane–chloroform–diethylamine (7 : 2 : 1), S_3, cyclohexane–chloroform–diethylamine (4 : 5 : 1), ethanol–water–aqueous ammonia (15 : 9 : 1), S_5, methanol–water–aqueous ammonia (5 : 1 : 1), and S_6, ethanol–acetic acid–water (6 : 3 : 1), or, on ready-for-use Kavalier Glasswork Silufol UV_{254} silica gel foils in the solvent system S_7, cyclohexane–methanol (3 : 1) and S_8, methanol–diethylamine (4 : 1). Paper chromatography was performed by the descending technique on paper Whatman No 1 in the solvent system 1-butanol–acetic acid–water (10 : 1 : 3). Fluorescent spots were detected under the UV light, other spots were made visible with the potassium iodoplatinate or Dragendorff reagent.

Extraction and Isolation of Alkaloids

The plants were cultivated in the Experimental Botanic Garden of the Medical Falculty, J. E. Purkyně University, Brno, from seeds of the same origin as reported in the earlier paper[1], harvested in the stage of blossoms and immature fruits on June 27th, 1969 and July 1st, 1970, and dried at room temperature. The whole dried plants were ground (3738 g) and extracted with ethanol in a Soxhlet apparatus. From the extract, there were isolated the alkaloid fractions *A*, *B*, *I*, and *E* with the use of the reported procedure[1].

Fraction *A* was separated into the non-phenolic bases (A_1) and the phenolic ones (A_2). Crystallisation of fraction A_1 from chloroform–ethanol and ethanol afforded protopine (overall yield, 2·88 g; 0·077%) and allocryptopine (overall yield, 0·70 g; 0·020%). From the remaining bases, there were obtained the quaternary benzophenanthridines (18·4 mg; 0·0005%) in the form of nonbasic pseudocyanides consisting (as shown by chromatography in S_7 and S_8) from sanguinarine, chelerythrine, and chelirubine. The remaining bases were converted into hydrochlorides soluble (A_1C) and insoluble (A_1D) in chloroform. Crystallisation of fraction A_1C from ether afforded 0·06 g of a nonbasic substance, prisms, m.p. 144—145°C (Kofler block). As shown by thin-layer chromatography in S_1, S_2, and S_3, the amorphous residue (110 mg) contained at least 7 alkaloids, one of which is obviously identical with corydine. Fraction A_1D (90 mg) afforded 30 mg of protopine. Fraction A_2 (50 mg) was amorphous and represented (as shown by thin-layer chromatography in S_1, S_2, and S_3) a mixture of at least ten bases, one of which is obviously identical with scoulerine.

Fraction *B* (75 mg) contained (thin-layer chromatography in S_8 and S_9) as the principal component a non-alkaloidal yellow dyestuff along with trace amounts of coptisine and berberine.

Fraction I. Crystallisations of the iodides from water afforded 10·53 g of escholamine iodide (overall yield including crops obtained from mother liquors was 11·16 g of the iodide; 0·30%). Aqueous mother liquors after crystallisations of the crude escholamine iodide afforded 56 mg of escholamidine iodide (overall yield, 115 mg; 0·003%). The residual amorphous iodides were dissolved in boiling water and the solution was precipitated with 20% aqueous sodium perchlorate. The precipitate was crystallised from methanol to afford a mixture (0·64 g) of escholamine perchlorate and escholamidine perchlorate; the attempted separation of these perchlorates by additional crystallisations from methanol did not meet with success. Finally, the different solubility of the perchlorates in 5% aqueous sodium hydroxide was made use of. The soluble one was converted into the iodide and this salt purified by crystallisation from water to afford 49 mg of escholamidine iodide; the insoluble perchlorate was analogously converted to escholamine iodide. Systematic crystallisation (from methanol) of mother liquor components after the separation of escholamine perchlorate and escholamidine perchlorate afforded (—)-α-stylopine methoperchlorate (36·4 mg; overall yield, 42·5 mg *i.e.* 0·001%) and perchlorates of the alkaloids ES 1 and ES 2 (5·2 mg and 1·0 mg, resp.). The amorphous residual perchlorates were separated on the basis of solubility (*IC*) and insolubility (*ID*) in chloroform. Crystallisation of fraction *IC* from methanol afforded a mixture (20·8 mg) of californidine perchlorate and escholamine perchlorate; additional crystallisations of this mixture afforded 13·3 mg of californidine perchlorate (0·0004%). The residue remaining after purification of fraction *IC* was practically alkaloid-free. Crystallisation of perchlorates *ID* from methanol afforded a mixture (50 mg) of escholamine perchlorate and escholamidine perchlorate and 6·1 mg of (—)-α-stylopine methoperchlorate. The residual amorphous perchlorates *ID* (292 mg) were separated on the basis of their solubility in 5% aqueous sodium hydroxide to the non-phenolic (ID_1) and phenolic (ID_2) fraction. Fraction ID_1 yielded 28·4 mg of escholamine perchlorate while the fraction ID_2 (117 mg) remained amorphous. Fraction *E* was amorphous and has not been investigated in detail.

Escholamine iodide. Needles from water, m.p. 265—266°C (capillary) or 291—292°C (Kofler block). Mass spectrum: *m/e* 321 (*IVa*), 320, 307 (*IIIa*), 306, 142 (CH_3I), 127 (I). For UV and IR spectra and colour reactions see the earlier paper[1].

Escholamine perchlorate. Needles from methanol, m.p. 213—215°C (Kofler block). R_F values: 0·35 (S_4), 0·34 (S_5), 0·66 (S_6), 0·64 (S_9). With conc. sulfuric acid, the perchlorate is colourless and then transient light violet and light gray-green colours may be observed; the Erdmann reagent affords a deep violet colour.

Escholamidine iodide. Small prisms from water; they become red-brown on air. In the capillary, m.p. sharply 214—215°C; in the Kofler block, m.p. 118—122°C, at about 180°C transformation into needles which remelt at 212—214°C. The iodide is poorly soluble in cold water or cold methanol, and readily soluble in 5% aqueous sodium hydroxide. Mass spectrum: *m/e* 323 (*IVb*). 322, 309 (*IIIb*), 308, 142 (CH_3I), 127 (I). UV spectrum: λ_{max} (log ε) 254 nm (4·80), 285 nm (3·90), 3·14 nm (4·05); λ_{min} 275 nm (3·87), 297 nm (3·87); shoulder 345 nm (3·92). R_F values: 0·34 (S_4), 0·59 (S_5), 0·68 (S_6), 0·53 (S_9). With sulfuric acid: light brown, then yellow; with the Erdmann reagent: light red-violet, then light violet; with nitric acid: yellow.

Tetrahydroescholamidine. Escholamidine iodide (27·0 mg) was reduced with a mixture of zinc and hydrochloric acid and acetic acid (5—10%) on a boiling water bath for 2·5 h, the solid filtered off, the filtrate made strongly alkaline with aqueous ammonia, extracted repeatedly with ether, the ethereal extract concentrated and the concentrate diluted with hexane to deposit clusters of needles (17·0 mg; 87%), m.p. 119—120°C (Kofler block). UV spectrum: λ_{max} (log ε) 288 nm (3·78), λ_{min} 258 nm (3·08). R_F value: 0·23 (tetrahydroescholamine, 0·84) in S_2.

(—)-α-*Stylopine methohydroxide.* The iodide was crystallised from methanol; m.p. 278—280°C (Kofler block) or m.p. 272—273°C (capillary); no depression on admixture with an authentic specimen prepared from (—)-stylopine (*vide infra*); poorly significant depression on admixture with (—)-β-stylopine methiodide (mixed m.p. in the capillary 268—270°C). Optical rotation: $[\alpha]_D^{23}$ —124 ± 5° (*c* 0·14, methanol). The IR spectrum (KBr) was identical with that of an authentic specimen but differed from that of the β-form methiodide. UV spectrum, shoulder at 245 nm (log ε 3·90), λ_{max} (log ε) 290 nm (3·92), λ_{min} 261 nm (3·07), was identical with those of authentic α- as well as β-forms of stylopine methiodide. The perchlorate was crystallised from methanol to afford needles, m.p. 328—330°C (Kofler block), depressed on admixture with (—)-β-stylopine methoperchlorate (mixed m.p., unsharply 310—318°C). The perchlorate is very little soluble in methanol. Optical rotation: $[\alpha]_D^{23}$ —168 ± 5° (*c* 0·10, methanol). The IR spectrum differs from that of the β-form perchlorate. The UV spectrum, λ_{max} (log ε) 242 nm (4·01), 290 nm (4·00), λ_{min} 225 nm (3·90), 262 nm (3·26), is the same as that of the β-form perchlorate. The R_F values in all experimental solvent systems were identical with those of the authentic α-form (*vide infra*). With conc. sulfuric acid: violet after a while; with the Erdmann reagent: first violet, then intensively blue-green and deep blue; with conc. nitric acid: yellow; the same colour reactions are exhibited by the α- and β-forms of stylopine methoperchlorate obtained from (—)-stylopine.

Californidine. Perchlorate (from methanol), m.p. 327—329°C (Kofler block), undepressed on admixture with an authentic specimen. Optical rotation, $[\alpha]_D^{23}$ —219 ± 10° (*c* 0·10, methanol), UV spectrum, R_F values (0·35 in S_4, 0·31 in S_5, and 0·63 in S_6), and colour reactions corresponded to properties of the authentic specimen (see ref.[3]).

Alkaloid ES 1. Perchlorate (from methanol), m.p. 252—257°C (Kofler block). UV spectrum: λ_{max} (log ε) 209 nm (4·09), 289 nm (3·72), shoulder at 235 nm (3·74), λ_{min} 259 nm (3·24). R_F values: 0·67 (S_4) and 0·80 (S_5). With conc. sulfuric acid: first bluish violet, then violet; with the Erdmann reagent: deep violet, then reddish violet.

Alkaloid ES 2. Perchlorate (from methanol), m.p. 265–275°C (Kofler block). R_F values: 0·55 (S_4) and 0·67 (S_5).

Isolation of (−)-α-Stylopine Methohydroxide from *Eschscholtzia californica* CHAM., *Argemone ochroleuca* SWEET, and *A. platyceras* LINK et OTTO

A. One of the crystalline perchlorates isolated from the root of *E. californica* (cf.[11]) was identical with (−)-α-stylopine methoperchlorate (yield, 5 mg from 1934 g of the dry root) on the basis of the m.p. value of 328–330°C (Kofler block), mixed melting point determination, UV spectra, and R_F values in S_4 and S_9.

B. The whole crop of the crude (−)-stylopine methiodide or methoperchlorate isolated from *A. ochroleuca* and *A. platyceras* was repeatedly crystallised from methanol to afford the earlier reported[9,10] product which represents (according to the melting point value, IR spectrum, and R_F value in S_9) the β-form (about 10% of the whole amount). The portion of the substance (about 90%) remaining in mother liquors is identical (according to the melting point value, IR spectrum, and R_F value in S_9) with (−)-α-stylopine methiodide and methoperchlorate, resp.

Preparation of (−)-α- and (−)-β-Stylopine Methiodide

To a solution of (−)-stylopine (100 mg) in chloroform (4 ml) there was added methanol (2 ml), ether (5 ml), and methyl iodide (1 ml). After 3 days, the solid (140·8 mg; 98%) was collected with suction and crystallised repeatedly from methanol to afford 125·0 mg of (−)-β-stylopine methiodide. The (−)-α-stylopine methiodide was obtained from mother liquors by a systematic crystallisation from methanol (yield, 5·8 mg).

(−)-α-*Stylopine methiodide.* M.p. 275–280°C (methanol) (Kofler block); $[\alpha]_D^{23}$ −125 ± 5° (*c* 0·10, methanol). The IR spectrum (in KBr) differed from that of the β-form especially in the 800–950 cm^{-1} region (bands at 810, 835, 860, 895, 915, and 940 cm^{-1}). The UV spectrum was identical with that of the β-form (*vide supra*). R_F values: 0·45 (S_4), 0·42 (S_5), and 0·76 (S_6).

(−)-β-*Stylopine methiodide.* Needles from methanol, m.p. 297–299°C (Kofler block) or 278 to 279°C (capillary); very poorly soluble in methanol. Optical rotation: $[\alpha]_D^{23}$ −120 ± 5° (*c* 0·13, methanol). The IR spectrum (in KBr) differs from that of the α-form (bands at 800, 850, 875, 915, and 930 cm^{-1}). The UV spectrum is identical with that of the α-form. R_F values: 0·50 (S_4), 0·49 (S_5), and 0·79 (S_6).

(−)-β-*Stylopine methoperchlorate.* Crystals from methanol, m.p. 338–340°C (Kofler block), very poorly soluble even in boiling methanol. Optical rotation: $[\alpha]_D^{24}$ −164 ± 5° (*c* 0·10, methanol).

(±)-Tetrahydropseudocoptisine Methiodide

Pseudocoptisine iodide[8] (40 mg) was dissolved in a boiling mixture of methanol (10 ml) and water (10 ml), the solution cooled down, and reduced with sodium borohydride (0·10 g). After 20 min, the mixture was acidified with dilute sulfuric acid, the methanol evaporated, the residual solution made alkaline with aqueous ammonia, and extracted with ether. Yield, 23·9 mg (83%) of (±)-tetrahydropseudocoptisine as needles, m.p. 211–213°C (Kofler block) in accordance with the reported[8] value. (±)-Tetrahydropseudocoptisine (18 mg) was dissolved in chloroform (1 ml), the solution treated with ether (3 ml) and methyl iodide (0·5 ml), and the mixture kept at room temperature for 24 h to yield 25 mg of a solid (96·6%). Crystallisation from methanol afforded 16 mg of (±)-β-tetrahydropseudocoptisine methiodide, m.p. 298–301°C (Kofler block).

IR spectrum in KBr (800—950 cm^{-1} region): bands at 845, 875, and 935 cm^{-1}. UV spectrum (ethanol): λ_{max} (log ε) 213 nm (4·32), 290 nm (3·94), shoulder at 222 nm (4·22), λ_{min} 260 nm (3·37). R_F values: 0·46 (S_4), 0·42 (S_5), and 0·76 (S_6). With conc. sulfuric acid: brown-violet, then gray-brown; with the Erdmann reagent: first brown-violet, then olive and brown. The mother liquor was evaporated and the residue (6·5 mg) chromatographed in the solvent system S_9 to show the exclusive presence of the α-methiodide (*vide infra*).

R_F Values of Some Tetrahydroprotoberberine α- and β-Methiodides in Paper Chromatography

In the solvent system S_9, the following R_F values were found: (—)-stylopine methiodide, α-form 0·72, β-form 0·61; (—)-canadine methiodide, α-form[14] 0·75, β-form[6] 0·62; (—)-tetrahydropalmatine methiodide[9], α-form 0·75, β-form 0·60; (—)-scoulerine methiodide[15], α-form 0·65, β-form 0·44; (±)-tetrahydropseudocoptisine methiodide, α-form 0·75, β-form 0·60.

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REFERENCES

1. Slavíková L., Slavík J.: This Journal *31*, 3362 (1966).
2. Birch A. J., Jackson A. H., Shannon P. V. R., Varma P. S. P.: Tetrahedron Letters *47*, 4789 (1972).
3. Slavík J., Slavíková L., Haisová K.: This Journal *32*, 4420 (1967).
4. Gertig H.: Acta Polon. Pharm. *22*, 443 (1965).
5. Ohashi M., Wilson J. M., Budzikiewicz H., Shamma M., Slusarchyk W. A., Djerassi C.: J. Am. Chem. Soc. *85*, 2807 (1963).
6. Novák V., Dolejš L., Slavík J.: This Journal *37*, 3346 (1972).
7. Preíninger V., Šimánek V., Dolejš L., Gašić O., Němečková A., Šantavý F.: This Journal *38*, 3662 (1973).
8. Sebe E., Ishigami K., Aizawa T., Tsuchida S.: J. Chin. Chem. Soc. (Taiwan) *14*, 91 (1967).
9. Haisová K., Slavík J.: This Journal *38*, 2307 (1973).
10. Slavík J., Slavíková L., Haisová K.: This Journal *38*, 2513 (1973).
11. Slavík J., Dolejš L.: This Journal *38*, 3514 (1973).
12. Haisová K., Slavík J.: This Journal, in press.
13. Slavíková L., Slavík J.: Unpublished results.
14. Slavík J., Dolejš L., Sedmera P.: This Journal *35*, 2597 (1970).
15. Haisová K., Slavík J., Dolejš L.: This Journal *38*, 3312 (1973).

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