Phytochemistry, Vol. 27, No. 10, pp. 3337 3339, 1988.
Printed in Great Britain.

0031 9422/88 $3.00+0.00
Pergamon Press plc.

ARISTOLASOL AND ARISTOLASENE: INDOLE ALKALOIDS FROM *ARISTOTELIA AUSTRALASICA*

J. C. QUIRION, C. KAN-FAN, I. R. C. BICK* and H. P. HUSSON†

Institut de Chimie des Substances Naturelles du CNRS 91198, Gif-Yvette Cedex, France

(*Received* 22 *January* 1988)

Key Word Index—*Aristotelia australasica*; indole alkaloids; Elaeocarpaceae.

Abstract—Aristolasol and aristolasene, two *Aristotelia* alkaloids, contain a new skeleton. Their structures were established by ^{1}H and ^{13}C NMR and mass spectrometric data.

Twenty-five alkaloids have previously been isolated from four species of *Aristotelia* (Elaeocarpaceae) [1, 2]. A possible mode of biogenesis of these alkaloids has been proposed [1], involving the condensation of a tryptamine unit with a non-rearranged monoterpene unit. From *Aristotelia australasica*, 18 alkaloids have been isolated [3–5]. In this paper we report the isolation and structure determination of two minor bases of a new type.

The first of these compounds, aristolasol **1**, was obtained as an oil, $[\alpha]_D^{20}$ +36° ($CHCl_3$, *c* 0.6). From its molecular formula $C_{20}H_{26}N_2O_2$ (calc.: 326.1994, found: 326.1989) it appeared to have two oxygen atoms more than aristoteline **3**, the parent compound of *Aristotelia* alkaloids. It had an indole nucleus from its UV spectrum, while its IR spectrum suggests the presence of one hydroxyl (3300 cm^{-1}) and no carbonyl functions. Its ^{1}H NMR spectrum showed that aristolasol is a disubstituted indole (four aromatic protons). The typical pattern of the three protons H-8a, H-8b and H-9 can be identified, but there were only two methyl signals at 0.93 and 1.22 ppm, which indicated that aristolasol does not possess the same skeleton as aristoteline **3**; there was also a singlet for one proton at 4.83 ppm which was not observed in the previously isolated alkaloids. The ^{13}C NMR spectrum displayed the presence of four tertiary and four quaternary aromatic carbons; in the aliphatic part of the spectrum the characteristic signals of the C-8, C-9, C-12, C-13, C-14, C-15 and C-16 of aristoteline appeared, but one of the methyl peaks and the C-11 were missing. We noted two signals at 76.2 (CH) and 75.3 (C_q), which might be attributed to carbons bearing a hydroxyl function. The mass spectral data and the chemical shifts, multiplicities and coupling constants oberserved in the ^{1}H and ^{13}C NMR spectra are all consistent with the proposed structure **1**. The small amounts of product did not allow the study of the relative configuration of the C-17. This alkaloid is the first one possessing a seven-membered ring to be isolated from *Aristotelia* spp.

The second minor alakloid, named aristolasene, was isolated from the same extract as a yellow oil, ($C_{20}H_{22}N_2$ calc.: 290.1776, found: 290.1746) $[\alpha]_D^{20}$ +493° ($CHCl_3$; *c* 0.9). Its UV spectrum showed long wave absorptions: 215, 262 and 330 nm, which indicated the presence of a conjugated indole nucleus. As in the case of aristolasol, its ^{1}H NMR spectrum exhibited four aromatic protons and only two methyl singlets. Three deshielded signals were observed at 6.59 (*d*, $J=9.5$ Hz), 6.40 (*s*) and 6.10 ppm (*dd*, $J=9.5$ and 7.5 Hz); two of these protons were mutually coupled, which indicated the presence of a disubstituted double bond. By irradiation of the different signals it was possible to attribute the H-8, H-9, H-12, H-13 and H-14 resonances. The last one was coupled with the olefinic proton at 6.10 ppm, so the double bond is located between C-15 and C-16. The chemical shifts and coupling constants of H-15 and H-16 are the same as those observed for sorreline **4** [6]. These data are in agreement with the structure **2** for aristolasene. The singlet observed at 6.40 ppm was attributed to the H-17.

Like aristolasol **1**, aristolasene **2** possesses a seven membered C-ring. The biogenesis of these two alkaloids may be explained by the attack of the indole nucleus on the carbon C-17 of the epoxides **6** and **8** derived from makomakine or sorreline respectively. By allylic oxidation of the alcohol **7**, aristolasol **1** would be obtained; on the other hand dehydration of **9** would furnish aristolasene **2**.

EXPERIMENTAL

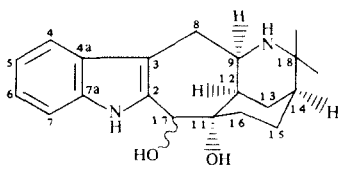
UV spectra were run in EtOH soln. ^{1}H NMR spectra were recorded in $CDCl_3$ (TMS as an int. standard, $\delta=0$ ppm). ^{13}C NMR spectra were recorded in $CDCl_3$ (50.33 MHz).

Isolation of the alkaloids. The extraction of aerial parts of *Aristotelia australasica* (3.5 kg) by classical procedures furnished 13 g of crude alkaloids. After dissolution in the mixture MeOH–$CHCl_3$ (7:3) and filtration on Sephadex LH 20 column, monomeric (4,5) and dimeric [3] alkaloids were separated. Monomers were then purified on silica gel column chromatography followed by prep. TLC. Aristolasol **1** (18 mg) and aristolasene **2** (10 mg) were obtained as amorphous products.

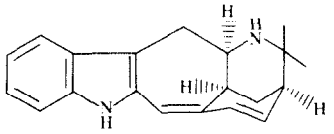
Aristolasol **1**. Oil, $[\alpha]_D^{20}$ +36° ($CHCl_3$; *c* 0.6) UV λ_{max}^{EtOH} (log ε): 222 (4.33), 281 (3.85), 289 nm (3.83); IR ν_{max}^{film}: 3500, 3350 cm^{-1}. MS

*Chemistry Department, University of Tasmania, Hobart, Australia.

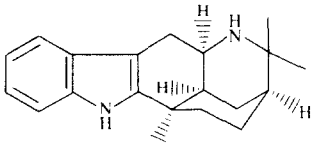
†Author to whom correspondence should be addressed.



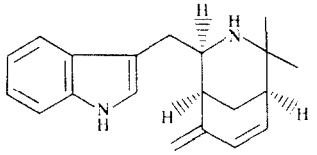
1
Aristolasol



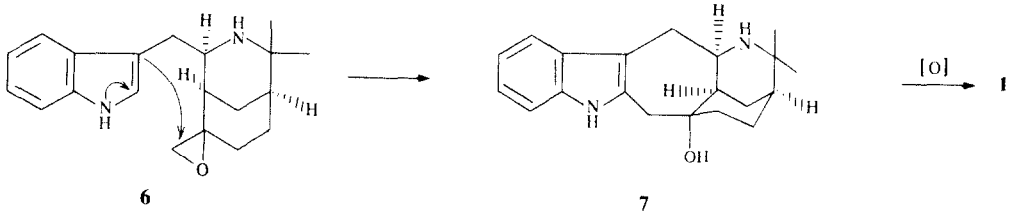
2
Aristolasene



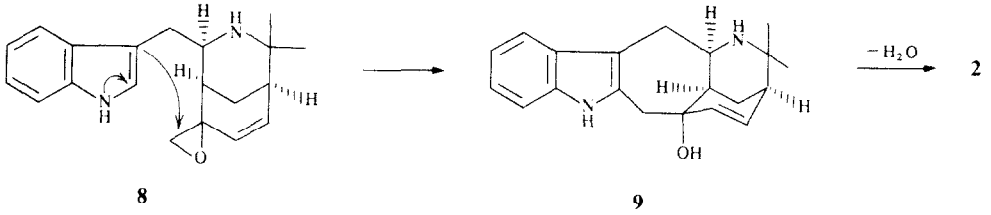
3
Aristoteline



4
Sorreline



6 **7** [O] → **1**



8 **9** $-H_2O$ → **2**

(70 eV) *m/z* (%): 326 (46), 311 (35), 308 (18), 293 (11), 251 (20), 166 (100), 130 (42); M^+ calcd for $C_{20}H_{26}N_2O_2$: 326.1994, found: 326.1989; ^1H NMR ($CDCl_3$, 400 MHz): 0.93 and 1.22 (2Me, *s*), 1.32 (1H, *ddt*, *J* = 5,3 and 1.5 Hz, H-14), 1.40 (1H, *ddt*, *J* = 15, 14 and 6 Hz, H-16ax), 1.57 (1H, *ddd*, *J* = 15, 5 and 1.5 Hz, H-16eq), 1.69 (1H, *tt*, *J* = 14 and 5 Hz, H-15ax), 1.80 (2H, *m*, H-12 and H-15eq), 1.97 (1H, *ddd*, *J* = 14, 4 and 1.5 Hz, H-13), 2.20 (1H, *br s*, N-10H), 2.31 (1H, *dt*, *J* = 14 and 3 Hz, H-13), 2.87 (1H, *dd*, *J* = 15 and 1.5 Hz, H-8), 3.20 (1H, *dd*, *J* = 15 and 4 Hz, H-8), 3.51 (1H, *dt*, *J* = 4 and 1.5 Hz, H-9), 4.83 (1H, s, H-17), 7.08 (1H, *t*, *J* = 7.5, H-6), 7.15 (1H, *t*, *J* = 7.5 Hz, H-5), 7.35 (1H, *d*, *J* = 7.5 Hz, H-7), 7.63 (1H, *d*, *J* = 7.5 Hz, H-4), 8.70 (1H, *br s*, N1H). ^{13}C NMR ($CDCl_3$): 140.1 (C-7a), 134.8 (C-2), 130.0 (C-4a), 121.0 (C-5), 119.4 (C-4), 118.4 (C-6), 111.0 (C-7), 105.8 (C-3), 76.2 (C-17), 75.3 (C-11), 53.5 (C-18), 53.3 (C-9), 44.2 (C-12), 36.0 (C-14), 29.4 (C-8), 28.1 (Me), 28.1 (C-16), 27.5 (Me), 26.2 (C-15), 23.7 (C-13).

Aristolasene **2**. Oil, $[\alpha]_D^{20}$ +493° ($CHCl_3$; *c* 0.9), UV λ_{max}^{EtOH} (log ε): 215 (4.13), 262 (3.90), 330 nm (3.89); IR λ_{max}^{film}: 3400, 1460 cm^{-1}. MS (70 eV) *m/z* (%): 290 (100), 233 (92), 232 (81), 221 (65), 218 (92), 217 (49), 207 (24), 206 (2), 182 (27), 167 (16), 85 (51), 83 (70). M^+ calculated for $C_{20}H_{22}N_2$: 290.1776, found: 290.1746. ^1H NMR ($CDCl_3$) 1.06 and 1.30 (2 Me, *s*), 1.76 (1H, *dt*, *J* = 13 and 3.5 Hz, H-13), 1.91 (1H, *dd*, *J* = 15 and 8.5 Hz, H-8), 1.98 (1H, *dt*, *J* = 13 and 1.5 Hz, H-13), 2.11 (1H, *ddd*, *J* = 7.5, 3.5 and 1.5 Hz, H-14), 2.46 (1H, *ddd*, *J* = 3.5 and 1.5 Hz, H-12), 3.45 (1H, *dd*, *J* = 15 and 8.5 Hz, H-8), 3.93 (1H, *td*, 8.5 and 2 Hz, H-9), 6.10 (1H, *dd*, *J* = 9.5 and 7.5 Hz, H-15), 6.40 (1H, *s*, H-17), 6.59 (1H, *d*, *J* = 9.5 Hz, H-16), 7.10 (1H, *t*, *J* = 7.5 Hz, H-6), 7.15 (1H, *t*, *J* = 7.5 Hz, H-5), 7.31 (1H, *d*, *J* = 7.5 Hz, H-7), 7.65 (1H, *d*, *J* = 7.5 Hz, H-4), 8.03 (1H, *br s*, N1-H).

REFERENCES

1. Bick, I. R. C. (1985) *The Alkaloids* (Brossi A., ed.) vol XXIV, p. 113. Academic Press, New York.
2. Bick, I. R. C., Hai, M. A. and Preston, N. W. (1985) *Tetrahedron* **41**, 3127.
3. Quirion, J.-C., Kan, C., Bick, I. R. C. and Husson, H.-P. (1987) *J. Org. Chem.* **52**, 4527.
4. Quirion, J.-C., Kan, C., Bick, I. R. C. and Husson, H.-P. (1988) *J. Nat. Prod.* (in press).
5. Kan C., Quirion, J.-C., Bick, I. R. C. and Husson, H.-P., (1988) *Tetrahedron* **44**, 1651.
6. Kyburz, R., Schopp, E., Bick, I. R. C. and Hesse, M. (1979) *Helv. Chim. Acta* **62**, 2539.

Phytochemistry, Vol. 27, No. 10, pp. 3339–3341, 1988.
Printed in Great Britain.

0031-9422/88 $3.00+0.00

NUPHACRISTINE—AN ALKALOID FROM NUPHAR LUTEUM

JACEK CYBULSKI, KRYSTYNA BĄBEL, KRYSTYNA WOJTASIEWICZ, JERZY T. WRÓBEL* and DAVID B. MACLEAN†

Department of Chemistry, University of Warsaw, ul. Pasteura 1, 02–093 Warszawa, Poland; †Department of Chemistry, McMaster University, Hamilton, Ontario, Canada, L8S 4M1

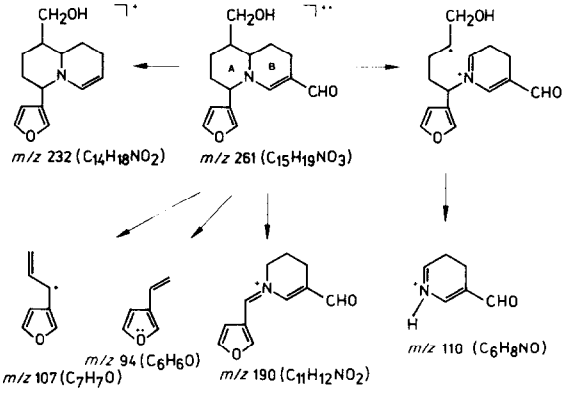
(*Received* 28 *October* 1987)

Key Word Index—*Nuphar luteum*; Nymphaeaceae; C_{15} alkaloid; nuphacristine.

Abstract—From the rhizomes of *Nuphar luteum* a new C_{15} alkaloid, nuphacristine, has been isolated. The structure and stereochemistry of nuphacristine have been established on the basis of spectral analysis and chemical transformations.

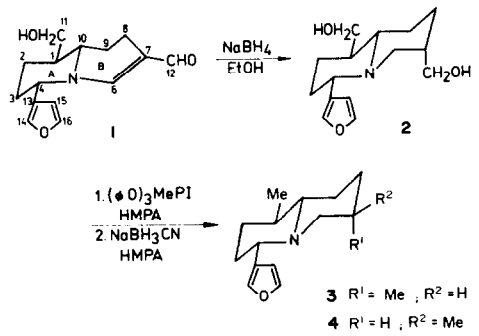
INTRODUCTION

From the rhizomes of *Nuphar luteum* a number of monomeric ($C_{15}N$) and dimeric ($C_{30}N_2S$) alkaloids have been isolated and characterized [1]. The quinolizidine ring system is present in many of the monomeric alkaloids and in all of the dimeric, sulphur-containing alkaloids. Some alkaloids occur as *N*-oxides, and others in the dimeric series, as *S*-oxides; a hemiaminal system is also present in some alkaloids [1]. We present here the structure and stereochemistry of a newly isolated $C_{15}N$ alkaloid, nuphacristine **1**, which has a novel array of functional groups. It became evident from the composition of **1** ($C_{15}H_{19}NO_3$) and from the nature of its functional groups that it belonged to the $C_{15}N$ group of *Nuphar* alkaloids containing a quinolizidine ring system (Fig. 1).



RESULTS AND DISCUSSION

Nuphacristine **1** was isolated in the following manner. The crude alkaloids of *N. luteum* were first chromatographed on alumina affording three fractions of varying polarity. The chloroform–methanol fraction, the most polar fraction, was then rechromatographed twice on silica gel. In this way nuphacristine, which gave a positive Dragendorff test, was obtained. The structure of **1** was deduced from an examination of its ^1H and ^{13}C NMR spectra and its mass spectrum, and confirmed by chemical transformation to *Nuphar* alkaloids of established structure and stereochemistry.



*Author to whom correspondence should be addressed.