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Note

A tetrahydro β-carboline trisaccharide from *Palicourea coriacea* (Cham.) K. Schum

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Abstract—A new tetrahydro β-carboline alkaloid that has an oligosaccharide unit was isolated from the root extracts of the *Palicourea coriacea*. The structure was elucidated using spectral methods, including 2D NMR: COSY, HMQC, HMBC and NOESY.

Keywords: Rubiaceae; *Palicourea coriacea*; Tetrahydro β-carboline; Trisaccharide

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The genus *Palicourea* (Rubiaceae) comprises about 200 species, which are rich sources of triterpenes,[1] alkaloids,[2] fluoroacetate,[3] coumarins,[4] and macrocyclic peptides,[5] many of them possessing interesting biological properties. Recently, the extracts of *Palicourea* and the closely related genus *Psychotria* were screened at the US National Cancer Institute for their activities against human cancer one-dose/60-cell-line prescreen and were selected as 'hot' genera among over 90,000 extracts assayed.[6] The chemical and biological importance of the *Palicourea* species persuaded us to investigate *Palicourea coriacea*, a small shrub popularly called 'douradinha', which is well known in Brazilian Cerrado folk medicine as a potent diuretic. Our earlier work on the chemical components of the crude methanolic extracts from the leaves of *P. coriacea* revealed the occurrence of β-carboline alkaloids and triterpenes.[7] In this study, we report on the isolation and the structural elucidation of an unusual tetrahydro β-carboline trisaccharide alkaloid from the methanol extract of the root of *P. coriacea*.

A methanolic extract of the air-dried roots of *P. coriacea* was subjected to repeated chromatographic separation on silica gel using $CHCl_3$–MeOH mixtures of increasing polarity as eluent. Elution with 1:1 $CHCl_3$–MeOH afforded compound **1** as a yellow solid. The molecular formula was established as $C_{38}H_{52}N_2O_{19}$ by a combination of HREIMS, ^1H and ^{13}C NMR spectra.

The ^1H NMR spectrum displayed signals of four aromatic hydrogens at δ_H 7.44 (d, *J* 7.5 Hz; H-9), 7.03 (td, *J* 7.5 and 1.2 Hz; H-10), 7.12 (ddd, *J* 8.0; 7.5 and 1.2 Hz; H-11) and 7.30 (d, *J* 8.1 Hz; H-12), signals in the shift ranges appropriate for methylenes at δ_H 3.20 (m, H-5), 3.70 (m, H-5), 3.02 (m, H-6), 2.11 (ddd, *J* 14.9, 9.9 and 4.5; H-14B), 2.37 (td, *J* 14.4 and 3.3; H-14A); methines at δ_H 4.43 (br d, *J* 9.9, H-3), 3.00 (m, H-15), 2.70 (m, H-20) and 5.82 (d, *J* 9.3, H-21), four olefinic hydrogens at δ_H 7.56 (br s, H-17), 5.20 (d, *J* 10.8, H-18), 5.31 (d, *J* 17.4, H-18), 5.86 (ddd, *J* 17.4, 10.8, 7.3, H-19) and numerous midfield signals at δ 3.22–5.38, which are indicative of glycoside moieties.

The ^{13}C NMR spectrum showed resonances at δ_C 107.3 (C-7), 112.2 (C-12), 119.1 (C-9), 120.5 (C-10), 123.4 (C-11), 127.5 (C-8), 130.5 (C-2) and 138.2 (C-13), typical of a 2.3-disubstituted indole system, besides three methylenes at δ_C 19.6 (C-6), 35.1 (C-14) and 43.0 (C-5), four methynes at δ_C 34.0 (C-15), 45.7 (C-20), 52.3 (C-3) and 96.6 (C-21), three olefinic carbons at δ_C

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153.4 (C-17), 118.9 (C-18) and 136.3 (C-19) and a carbonyl group at δ_C 175.9 (C-22), further confirmed by the absorption in the IR spectrum at 1640 cm^{-1}. Additionally, two anomeric methine carbons at δ_C 100.4 and 93.6, four oxygenated methylenes, 11 oxygenated methynes and the quaternary anomeric carbon at δ_C 105.3 clearly indicated the presence of three sugar moieties in the structure of **1**.

The aglycon unit structure was deduced from H,H and C,H connectivities of the COSY, HMQC and HMBC spectra. The data were consistent with **1** being a strictosidinic-type trisaccharide skeleton. The first step of the oligosaccharide analysis in compound **1** was the association of the two carbons at δ_C 100.4 and 93.6 with the relevant anomeric proton signals (δ_H 4.82 and 5.38, respectively) through the HMQC experiment. Analysis of the cross-peak in the COSY spectrum starting from the anomeric proton at δ_H 4.82 (H-1′) suggested the presence of five continuous methynes and one free methylene in sugar A. Once the proton assignments had been made, each proton was correlated to the relative carbon through the cross-peaks observed in the HMQC spectrum. Although it was not possible to calculate all the coupling constants, the large coupling constant between H-1′ and H-2′ (J 8.1 Hz), and the HMBC and NOESY spectra (Fig. 2) confirmed that the sugar unit A was a β-glucopyranosyl group. This residue is shown to be attached to the C-21 at δ_C 96.6 of the aglycon moiety on the basis of the HMBC cross-peaks H-21/C-1′ and reinforced by NOESY correlation between H-21/H-1′. Comparison of the aglycon and the sugar A signals in the ^{13}C NMR spectrum (Table 1) with those from strictosidinic skeletons clearly showed that compound **1** was the strictosidinic acid[8] with one disaccharide unit bound to its glucopyranosyl moiety.

Analysis of sugars B and C started with the correlation between anomeric carbon resonating at δ_C 93.6 (C-1″) with the anomeric proton signal at δ_H 5.38 in HMQC spectrum. Moreover, analysis of the cross-peak in the COSY spectrum starting from the anomeric methine at δ_H 5.38 (H-1″) revealed five methynes and one free methylene group (δ_C 62.2) indicating that the central sugar B was also a glucopyranosyl residue. Sugar C containing the two methylenes at 64.1 (C-1‴) and 63.4 (C-6‴), three oxygenated methines and the quaternary anomeric carbon at δ_C 105.3 (C-2‴) was consistent with a fructose moiety. The HMBC cross-peak between the anomeric proton at δ_H 5.38 (H-1″) of the glucose and the quaternary carbon at δ_C 105.3 (C-2‴) of the fructose, which in turn showed coupling to a methylene protons at δ_H 3.61 (H-1‴), helped to locate the ether linkage between the C-1″ and C-2‴carbons. This linkage pattern

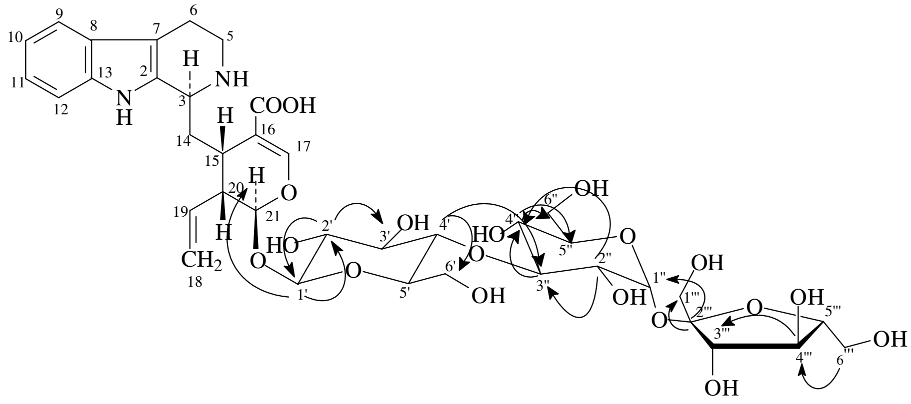

Figure 1. Structure **1** and HMBC correlations.

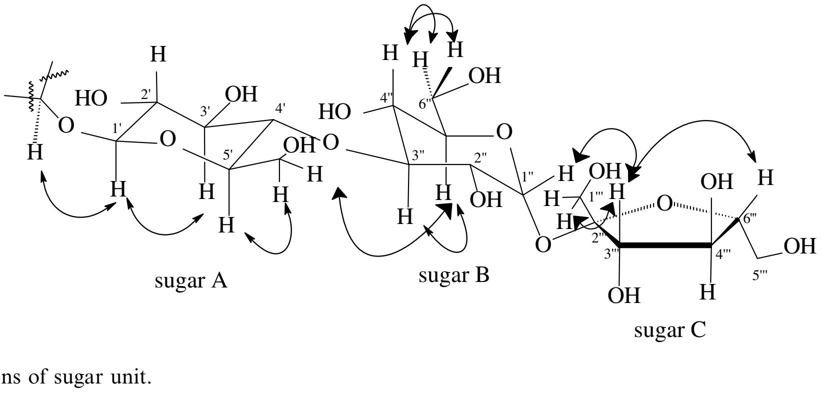

Figure 2. NOESY correlations of sugar unit.

Table 1. ^{1}H and ^{13}C NMR spectral data for compound **1**[a]

C-DEPT	δ ^{13}C	δ ^{1}H (multiplicity, *J* Hz)
2-C	130.5	—
3-CH	52.3	4.43 (br d, 9.9)
5-CH$_2$	43.0	3.20 (m)/3.70 (m)
6-CH$_2$	19.6	3.02 (m)
7-C	107.3	—
8-C	127.5	—
9-CH	119.1	7.44 (d, 7.5)
10-CH	120.5	7.03 (td, 7.5, 1.2)
11-CH	123.4	7.12 (ddd, 8.1, 7.5, 1.2)
12-CH	112.2	7.30 (d, 8.1)
13-C	138.2	—
14-CH$_2$	35.1	2.11 (ddd, 14.4, 9.9, 4.5)/2.37 (td, 14.4, 3.3)
15-CH	34.0	3.00 (m)
16-C	113.5	—
17-CH	153.4	7.56 (br s)
18-CH$_2$	118.9	5.20 (d, 10.8 cis)/5.31 (d, 17.4 trans)
19-CH	136.3	5.86 (ddd, 17.4, 10.8, 7.3)
20-CH	45.7	2.70 (m)
21-CH	96.6	5.82 (d, 9.3)
22-C	175.9	—
1′-CH	100.4	4.82 (d, 8.1)
2′-CH	74.8	3.22 (dd, 9.3, 8.1)
3′-CH	78.0	3.42 (dd, 9.3, 9,0)
4′-CH	71.8	3.24 (dd, 9.1, 9.0)
5′-CH	78.8	3.38 (dd, 11.4, 9.1)
6′-CH$_2$	63.1	4.01 (dd, 11.4, 1.5)/3.66 (m)
1″-CH	93.6	5.38 (d, 3.9)
2″-CH	73.2	3.40 (m)
3″-CH	74.7	3.68 (m)
4″-CH	71.3	3.35 (m)
5″-CH	74.4	3.80 (m)
6″-CH$_2$	62.2	3.70 (m)/3.78 (m)
1‴-CH$_2$	64.1	3.61 (d, 3.3)
2‴-C	105.3	—
3‴-CH	79.3	4.09 (d, 8.4)
4‴-CH	75.7	4.03 (m)
5‴-CH	83.8	3.74 (m)
6‴-CH$_2$	63.4	3.75 (m)

[a] ^{1}H and ^{13}C NMR assignments are based on ^{1}H–^{1}H COSY, HMBC, HMQC and NOESY spectra. Internal standard TMS. Measured in CD$_3$OD at 300 MHz and 75.5 MHz.

and the relative stereochemistry were also confirmed by NOESY experiments (Fig. 2). The coupling constant between H-1″ and H-2″ (*J* 3.9 Hz) and the comparison of the chemical shift in the ^{13}C NMR spectrum with those from the literature[9] completed the identification of the disaccharide as sucrose.

Finally, the ether linkage between C-4′ and C-3″ bonding the two groups, strictosidinic acid and sucrose, was supported by HMBC correlations (Fig. 1), especially the cross-peak between δ_H 3.68 (H-3″) and δ_C 71.8 (C-4′). A glycosidic linkage involving C-6′ or C-6″ was ruled out since the C-6′ and C-6″ signals at δ_C 63.1 and 62.2 were typical of primary alcohols.

Disaccharides such as hunterioside and hunterioside B have already been isolated from *Hunteria zeylanica*[10,11] and possess one additional unit of glucose at the C-6′ and C-3′ hydroxyl group of the strictosidinic acid. However, to the best of our knowledge, compound **1** is the first example of strictosidinic acid incorporating a sucrose unit.

1. Experimental

1.1. General experimental procedures

NMR spectra were recorded with a Varian Mercury plus BB spectrometer operating at 300 MHz for ^{1}H and at 75.457 MHz for ^{13}C. CD$_3$OD was used as the solvent, with Me$_4$Si (TMS) as internal standard. Optical rotations were measured with a Perkin–Elmer 341 polarimeter. HRMS was carried out using a Micromass VG AutoSpec spectrometer operating at 70 eV. IR was recorded with FTIR Bomem MB100 using KBr pellets.

1.2. Plant material

Aerial parts of *P. coriacea* were collected in Goiânia city, Goiás, Brazil and authenticated by Professor Heleno Dias Ferreira, Departamento de Botânica, Universidade Federal de Goiás. Voucher specimens were deposited at the herbarium of the Universidade Federal de Goiás under the number (≠27153).

1.3. Extraction and isolation of the compound 4′-*O*-3″-sucrose-strictosidinic acid

The air-dried and powdered roots (77 g) were extracted with MeOH using a Soxhlet apparatus for 40 h. The resulting extract was concentrated under reduced pressure to give 5.60 g of the crude methanolic extract. Hence, 1.30 g of this extract was subjected to column chromatography on Silica Gel 60 using CHCl$_3$ and MeOH mixtures of increasing polarity to give four major fractions (1–4). Repeated chromatography of fraction 3 using gradient elution with mixtures of CHCl$_3$ and MeOH from 100:0 to 50:50 gave compound **1** (10 mg) as a yellow solid.

Pale-yellow amorphous solid: mp 155–158 °C; $[\alpha]_D^{25}$ −60 (*c* 10.0, MeOH); IR (KBr) ν 3400, 1640, 1541, 1454, 1074 cm^{-1}; ^{1}H and ^{13}C NMR (CD$_3$OD, 300 and 75 MHz), see Table 1. HRMS: showed a $[M-H_2O_2]^+$ *m*/*z* 806.3109 (calculated *m*/*z* 806.3095).

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Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.carres.2008.01.032.

References

1. Bolzani, V. da S.; Trevisan, L. M. V.; Young, M. C. M. *Rev. Latinoamer. Quim.* **1992**, *23*, 20–21.
2. Dusman, L. T.; Jorge, T. C. M.; de Souza, M. C.; Eberlin, M. N.; Meurer, E. C.; Bocca, C. C.; Basso, E. A.; Sarragiotto, M. H. *J. Nat. Prod.* **2004**, *67*, 1886–1888.
3. Kemmerling, W. *Z. Naturforch., C: J. Biosci.* **1996**, *51c*, 59–64.
4. El-Seedi, H. R. *Rev. Latinoamer. Quim.* **1999**, *27*, 13–16.
5. Bokesch, H. R.; Pannell, L. K.; Cochran, P. K.; Sowder, R. C.; McKee, T. C.; Boyd, M. R. *J. Nat. Prod.* **2001**, *64*, 249–250.
6. Cragg, G. M.; Newman, David J.; Yang, S. S. *J. Nat. Prod.* **2006**, *69*, 488–498.
7. do Nascimento, C. A.; Gomes, M. S.; Lião, L. M.; de Oliveira, C. M. A.; Kato, L.; da Silva, C. C.; Tanaka, C. M. A. *Z. Naturforsch., B: Chem. Sci.* **2006**, *61b*, 1443–1446.
8. Simoes-Pires, C. A.; Farias, F. M.; Marston, A.; Queiroz, E. F.; Chaves, C. G.; Henriques, A. T.; Hostettmann, K. *Nat. Prod. Commun.* **2006**, *1*, 1101–1106.
9. Thompson, J.; Robrish, S. A.; Pikis, A.; Brust, A.; Lichtenthaler, F. W. *Carbohydr. Res.* **2001**, *331*, 149–161.
10. Subhadhirasakul, S.; Aimi, N.; Takayama, H.; Ponglux, D.; Sakai, S. *Chem. Pharm. Bull.* **1994**, *42*, 991–993.
11. Takayama, H.; Subhadhirasakul, S.; Ohmori, O.; Kitajima, M.; Ponglux, D.; Aimi, N. *Heterocycles* **1998**, *47*, 87–90.