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Isoquinoline alkaloids from the leaves of *Xylopia laevigata* (Annonaceae)

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1. Subject and source

Xylopia L. belongs to the Annonaceae family and comprises approximately 157 species of trees and shrubs (Chatrou et al., 2012) with pantropical distribution (Koek-Noorman and Westra, 2012). *Xylopia laevigata* (Mart.) R. E. Fries popularly known as 'meiú' and 'pindaíba' is a small tree endemic of Brazil found in the States of Paraíba, Piauí, Rio de Janeiro, São Paulo, and Sergipe (Pontes et al., 2004; Maas et al., 2001). In Sergipe, it is found in Atlantic forest remaining, sandbank forests and coastal boards. Its leaves are very similar those of certain species of *Oxandra* (Maas et al., 2001). In folk medicine its leaves and flowers are used to the treatment of painful disorders, heart diseases and inflammatory conditions (Quintans et al., 2013).

In the present investigation, the botanical material (leaves) of *X. laevigata* were collected in March 2010 from "Serra de Itabaiana", in the city of Itabaiana [coordinates: 10°44′53″ S and 37°20′21″ W], Sergipe State, Brazil. The identity of the plant was confirmed by Dr. Ana Paula do Nascimento Prata from Department of Biology of Sergipe Federal University (DBI/UFS), Brazil. A voucher specimen (number 15440) was deposited in the ASE herbarium of Sergipe Federal University, Brazil.

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2. Previous work

Previous phytochemical investigations on this species described the isolation and identification of diterpenoids (Silva et al., 2012) and essential oils (Costa et al., 2013; Quintans et al., 2013; Silva et al., 2013).

3. Present study

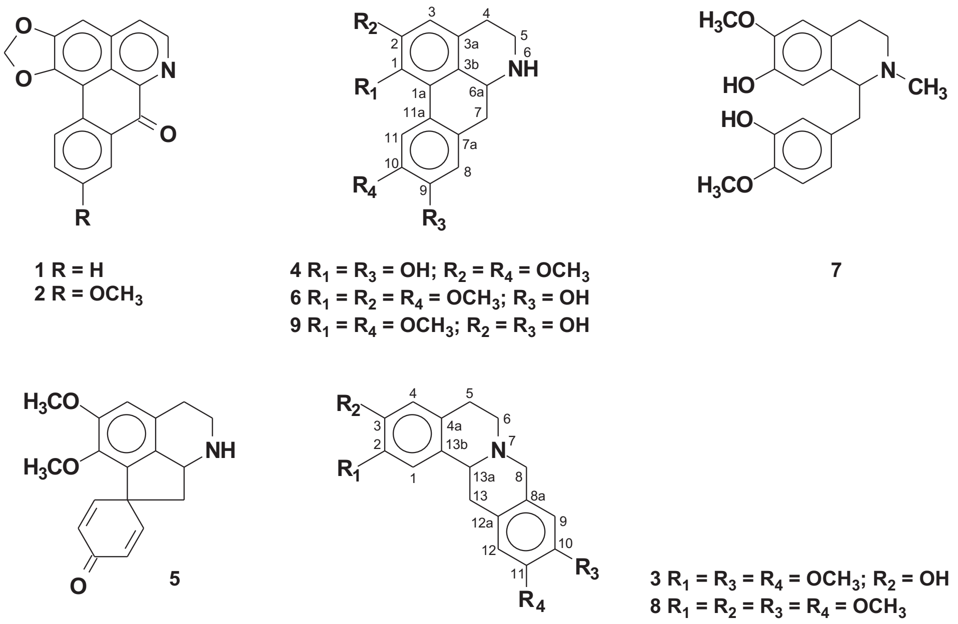
The dried and powdered leaves of *X. laevigata* (750.0 g) were extracted with hexane (3.0 L, five times), followed by MeOH (3.0 L, five times), yielding of hexane (54.32 g) and MeOH (191.12 g) extracts, after each solvent removal.

TLC analysis indicated a high concentration of alkaloids in the MeOH extract. Therefore, an aliquot of MeOH extract (186.00 g) was initially subjected to an acid-base extraction (Costa et al., 2006) to give alkaloid (1.40 g) and neutral (17.96 g) fractions. An aliquot of alkaloid fraction (1.1 g) was subjected to silica gel CC previously treated with a 10% $NaHCO_3$ solution (Costa et al., 2006), eluted with increasing concentrations of CH_2Cl_2 in hexane (100:0 to 10:90, v/v), followed by EtOAc in CH_2Cl_2 (100:0 to 30:70, v/v), and MeOH in EtOAc (100:0 to 50:50, v/v), giving 150 fractions (30 mL each). These fractions were evaluated and pooled according to TLC analysis yielding fifteen groups (GF1-GF15). Group GF2 (143.0 mg) was submitted to a new silica gel CC previously treated with a 10% $NaHCO_3$ solution, eluted with the same solvent system as described above affording 45 fractions (10 mL each) that were pooled in six groups (GF2.1 to GF2.6), according to TLC analysis. Group GF2.3 (18.5 mg) was subjected to a preparative TLC eluted with $CHCl_3$:MeOH (95:05, v/v, two times), giving a mixture of liriodenine and lanuginosine (**1** and **2**, respectively, 6.6 mg: Wirasathien et al., 2006; Costa et al., 2009, 2011a). Group GF2.4 (7.0 mg) was also subjected to a preparative TLC eluted with $CHCl_3$:MeOH (95:05, v/v, two times), affording lanuginosine (**2**, 3.3 mg; Wirasathien et al., 2006). Group GF3 (31.2 mg) was subjected to a preparative TLC eluted with $CHCl_3$:MeOH (90:10, v/v, three times), resulting in discretine (**3**, 2.3 mg; Hocquemiller et al., 1984; Ohiri et al., 1983), norisolboldine or laurelliptine (**4**, 1.3 mg; Guinaudeau et al., 1975), stepharine (**5**, 1.6 mg; Chang et al., 2000a) and a mixture of laurotetanine and reticuline (**6** and **7** respectively, 2.2 mg; Guinaudeau et al., 1975; Da Cruz et al., 2011). Group GF5 (80.0 mg) was also subjected to a preparative TLC eluted with $CHCl_3$:MeOH (90:10, v/v, three times) giving coreximine (**8**, 4.3 mg; Costa et al., 2009), laurotetanine (**6**, 1.5 mg; Guinaudeau et al., 1975) and norboldine (**9**, 3.1 mg; Chang et al., 2000b; Guinaudeau et al., 1975, 1994) (Fig. 1).

All isolated compounds (Fig. 1) were identified by a series of spectrometric methods, mainly MS and NMR (1D and 2D), as well as comparison with data reported in the literature. Although, discretine (**3**), laurotetanine (**6**) and norboldine (**9**) has been described a long time ago, their NMR data are incomplete and show ambiguities. Therefore, the complete and unequivocal NMR data for these alkaloids were reviewed according to 1D and 2D NMR experiments (Tables 1 and 2).

4. Chemotaxonomic significance

The present work reports the isolation and identification of nine isoquinoline alkaloids; two oxoaporphine, liriodenine (**1**) and lanuginosine (**2**); three aporphine, norisolboldine or laurelliptine (**4**), laurotetanine (**6**), and norboldine or laurolitsine (**9**);



1 R = H
2 R = OCH_3

4 $R_1 = R_3 = OH$; $R_2 = R_4 = OCH_3$
6 $R_1 = R_2 = R_4 = OCH_3$; $R_3 = OH$
9 $R_1 = R_4 = OCH_3$; $R_2 = R_3 = OH$

7

5

3 $R_1 = R_3 = R_4 = OCH_3$; $R_2 = OH$
8 $R_1 = R_2 = R_3 = R_4 = OCH_3$

Fig. 1. Isoquinoline alkaloids from the leaves of *Xylopia laevigata*.