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Chemical constituents of *Distictella elongata* (Vahl) Urb. (Bignoniaceae)

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ABSTRACT

Pectolinarin, a flavone heteroside, was isolated from *Distictella elongata* (Vahl) Urb. leaves ethanol extract, along with a mixture of ursolic, pomolic and oleanolic acids, besides β-sitosterol. Their structures were established on the basis of spectral analysis (^{1}H and ^{13}C NMR, ^{1}D and ^{2}D) and they were compared with literature. This is the first report on the occurrence of this flavonoid in a species of the Bignoniaceae family.

Key words: Bignoniaceae, *Distictella elongata*, pectolinarin, triterpenes.

INTRODUCTION

Bignonieae is a large and diverse clade of neotropical lianas. The group is widely distributed in the neotropics, occurring in Central America, Amazonia, the Atlantic forests of eastern Brazil, and the open dry forests and savannahs of Argentina, Bolivia, Brazil, and Paraguay. Bignonieae contains all the lianas of the Brazilian Bignoniaceae and most of the species (approximately 250 of the 350) are in the four large genera, *Arrabidaea*, *Adenocalymma*, *Anemopaegma* and Memora (Lohmann 2006). Distictella Kuntze is a genus of 18 species in this tribe. The species are lianas or, less frequently, shrubs (Pool 2009). Distictella elongata (Vahl) Urb. appears as Distictis elongata Bureau & K. Schum. in the FLORA BRASILIENSIS and its actual name is Amphilophium elongatum (Vahl) L.G. Lohmann (Cipriani et al. 2007, Bedir et al. 2009, Lohmann 2010).

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Bignoniaceae is characterized by the presence of terpenoids, flavonoids, alkaloids, and special aromatic derivatives of the shikimic acid pathway (Cipriani et al. 2007). A β-lapachone derivative was also previously obtained from the roots of *D. elongata* (Bedir et al. 2009).

In the present study, leaves ethanol extract (LEE) from *D. elongata* were phytochemically investigated affording the flavonoid di-O-glycoside pectolinarin (1) along with a mixture of the triterpenoids: ursolic, pomolic and oleanolic acids and β-sitosterol.

MATERIALS AND METHODS

General Experimental Procedures

Optical rotation was measured on a Bellingham + Stanley Ltda ADP 220 polarimeter, whereas Infrared (IR) spectra were recorded on a Perkin-Elmer Spectrum One spectrophotometer. Melting

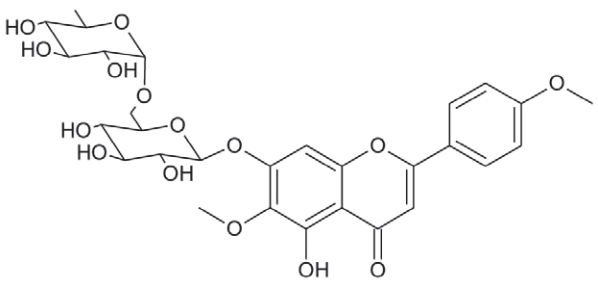

Fig. 1 - Structure of pectolinarin.

point was determined on an electrothermal digital apparatus (model MQAPF-30; Microquímica, Brazil), without correction. UV spectra were measured in a UV-2900 UV-VIS recording spectrophotometer (HITACHI, Japan). NMR spectra were obtained in DMSO-d6 with TMS as internal standard and they were recorded on a Bruker Avance DRX-400 equipment, (DQ/ICEX/UFMG). The MS system used was a quadrupole time-of-flight instrument (UltrOTOF-Q, Bruker Daltonics, Billerica, MA, U.S.A) equipped with an ESI positive and negative ion source. The analyses were performed with the mass spectrometer in positive mode. The following settings were applied throughout the analyses: capillary voltage 4500 V; dry gas temperature 150 °C; dry gas flow 4 L/min.; nebulizer gas nitrogen.

Plant Material

The leaves of *Distictella elongata* (Vahl) Urb. were collected in 2008 in the UFMG *Campus* Pampulha, Belo Horizonte, Minas Gerais State, Brazil. The species was identified by Dr. Lúcia Lohmann, Universidade de São Paula (USP), São Paulo, SP, and a voucher sample is deposited at the BHCB, UFMG, Belo Horizonte, Brazil, under the number 21.862.

Extraction and Isolation

Dried, powdered leaves (481 g) of *D. elongata* were extracted by percolation with EtOH 95%. After removing the solvent by evaporation under reduced pressure at 40°C, the leaves ethanol extract (LEE) (130.6 g; 27.2%) was obtained. Fractionation of LEE (7.4 g) was carried out by column chromatography (CC) on silica gel (740 g, 70-320 mesh - Merck®) eluting with *n*-hexane, *n*-hexane-CH_2Cl_2 (1:1), CH_2Cl_2, CH_2Cl_2-EtOAc (1:1), EtOAc, EtOAc-MeOH (1:1), MeOH and H_2O successively. The EtOAc fraction (500 mg) was further chromatographed over a flash silica gel column chromatography (15 g, 200-300 mesh - Merck®) eluted with n-hexane, n-hexane-EtOAc (1.7:0.3; 7:3; 1:1), and EtOAc. The n-hexane-EtOAc 7:3 fraction 21-35 (26 mg) was identified by TLC, ^1H and ^{13}C NMR as β-sitosterol in comparison with literature (Castilho and Kaplan 2008). The *n*-hexane-EtOAc 7:3 fraction 51-73 (99 mg) was submitted to preparative TLC using CH_2Cl_2-EtOAc (3:2) as eluent affording a mixture (17 mg) of ursolic, pomolic and oleanolic acids that were identified by ^1H and ^{13}C NMR. A portion of the EtOAc:MeOH (1:1) fraction (230 mg) was further purified by preparative reverse phase HPLC separation to give the flavone pectolinarin (17 mg).

Pectolinarin (1). Pale yellow amorphous powder; mp 248-351 °C; $[\alpha]_D^{22,4}$ (MeOH, 0.5 mg/mL): -0.06; UV $_{\lambda max}$ nm (MeOH): 273.5, 328.5, $_{\lambda max}$ nm (MeOH + NaOMe): 295, 370.5; $_{\lambda max}$ nm (MeOH + NaOAc): 273.5, (321-*sh*); $_{\lambda max}$ nm (MeOH + $AlCl_3$): 349, 298, 281.5; (MeOH + $AlCl_3$ + HCl): 348, 298, 281.5; IR ν_{max} (cm^{-1}): 3353 (OH), 1656 (C=O), 1608, 1583 (aromatic C=C), 1068 (C-O); ESI-MS $_{m/z}$: 623 $[M + H]^+$, 645 $[M + Na]^+$, 661 $[M + K]^+$.

Preparative HPLC

Pectolinarin was purified on a Shimadzu HPLC system (Japan) composed of pump LC-8A, UV-Vis detector SPD-GAV, controller system SCL-8A and integrator C-R4A. An ODS column (250 × 20 mm I.D., 10 mm; Shimadzu, Japan) was employed at room temperature, at a flow rate of 4.0 mL/min and UV220 detection. The mobile phase was consisted

of H_2O (solvent A) and MeOH (solvent B). The following segmented gradient was used: A-B (95:5, v/v) to A-B (40:60, v/v), in 2 min; A-B (40:60, v/v) to A-B (0:100, v/v), in 40 min; A-B (0:100, v/v) to A-B (95:5, v/v) in 20 min. HPLC grade solvents (Tédia, Brazil) were used and were degassed by sonication before use. Samples were dissolved in MeOH, in an ultrasonic bath for 20 min (25 mg/mL). After filtration through 0.45 μm membrane syringe filter, the sample solutions (200 μL) were injected into the apparatus.

RP-HPLC-DAD Profile

RP-HPLC-DAD analyses were carried out on a Waters alliance 2695 HPLC system composed of a quaternary pump, an auto sampler, a photodiode array detector (DAD) 2996 and a Waters Empower pro data handling system (Waters Corporation, Milford, USA). An ODS column (125 x 4.0 mm i.d., 5 mm; Merck, Darmstadt, Germany) was employed for the analysis. The profiles were performed employing a linear gradient of H_2O (A) and MeOH (B), A-B (95:5, v/v) to A-B (5:95, v/v) in 60 min; followed by 5 min of isocratic elution of A-B (5:95, v/v), at a temperature of 40°C and flow rate of 1.0 mL/min. The injection volume was 20 μL. The chromatograms were obtained at λ 220 nm UV spectra from λ 220 to 400 nm were recorded online. Samples were dissolved in MeOH, in ultrasonic bath for 20 min, and then filtrated at 0.45 μm membrane syringe filter, giving a final concentration of 10 mg/mL for extract and fractions, and 4 mg/mL for the isolated substance.

TLC Analyses

TLC plates (Merck, Silica gel 60 F254 – 0.25 mm); plates spots were detected under UV light (λ 365 nm), after spraying with anisaldehyde-H_2SO_4 reagent (general), Liebermann-Burchard reagent (terpenoids and steroids) or aluminium chloride (flavonoids) followed by heating.

Hydrolysis

The isolated flavone (2 mg) was hydrolysed in 2 M HCl in 20% aqueous methanol, by heating in a water bath at 80°C for 4 h (Hertog et al. 1992). The final solution was extracted with CH_2Cl_2. The aqueous layer was used for identification of the sugars by comparison with standards (β-D-glucose, α-L-rhamnose, β-D-galactose and α-L-arabinose; Sigma-Aldrich) in TLC with $CHCl_3$-MeOH-H_2O (70:30:4) as mobile phase and anisaldehyde-H_2SO_4 reagent as spraying reagent.

RESULTS AND DISCUSSION

The RP-HPLC profile of the LEE from *D. elongata* has shown the major peaks in the range of 19.0 to 31.0 min. The UV spectra registered online are characteristic of cinnamoyl derivatives: peaks with Rt 19.6 to 20.5 min; and flavones: peaks with Rt 26.5 to 31.0 min (Mabry et al. 1970). TLC phytochemical screening carried out for LEE indicated the presence of phenols, including flavonoids, terpenoids and/or steroids (Wagner et al. 1984).

Fractionation of LEE by column chromatography (CC) on silica gel yielded eight fractions. TLC analysis of the EtOAc fraction has shown mainly the presence of terpenoids and/or steroids. It was further chromatographed over a flash silica gel chromatography column to give 17 mg of a mixture of triterpenoids characterized by ^1H and ^{13}C NMR spectroscopy.

The ^1H NMR spectrum showed many signals at region δ 0.66-2.00 ppm corresponding to methyl and methylene hydrogens. The signal at δ 5.13 was attributed to the olefin hydrogen bonded to C-12 of ursane/oleanane triterpenoids (Castilho and Kaplan 2008). ^{13}C NMR spectra have shown the chemical shift of the carbinol and olefin carbons that led to the identification of the three terpenoids: ursolic, pomolic and oleanolic acids (Mahato and Kundu 1994).

TLC analysis of the EtOAc:MeOH (1:1) fraction has shown that it contained phenols only (Wagner et al. 1984). RP-HPLC-DAD analyses of the EtOAc and EtOAc:MeoH (1:1) fractions have shown a peak with retention time of approximately 31.0 min. The substance corresponding to this peak was isolated from the fraction EtOAc:MeOH (1:1), by preparative RP-HPLC, and was identified by spectrometric analyses.

The UV spectrum of the isolated substance was typical of a flavone (λ_{max} 273.5 and 328.5 nm). The presence of a free hydroxy group at C-5 and the absence of free hydroxy at C-4' and C-7 was indicated by the effects of $AlCl_3$ and NaOAc in the UV curve. The difference in band I in the methanol spectra (λ 328.5 nm) and after addition of NaOMe (λ 370.5 nm) is 42 nm with a decrease in intensity, indicating the absence of free OH at C-7 and C-4'. No modification of the UV curve, relatively to the $AlCl_3$ curve, after addition of HCl, indicated the presence of a free 5-hydroxyl group (Mabry et al. 1970, Markham 1982).

The 1D ^{1}H NMR spectrum showed an AA'XX' system of spins at δ 8.04 and 7.17 ppm (2H each, J = 8.0 Hz, 2' and 6'; 3' and 5', respectively) due to hydrogens in a 4′-oxygenated B ring. The doublets at 4.57 ppm (J = 1.1 Hz, H-1'") and δ 5.12 ppm (J = 4.00 Hz, H-1") are typical of anomeric hydrogens. The singlet at δ 12.96 ppm for the hydroxy proton indicate the formation of a hydrogen bond with the neighboring oxygen. H-8 and H-3 appeared as singlets at δ 6.94 and 6.93 ppm, respectively. The doublet at δ 1.06 (3H, J = 4.0 Hz, H-6'") was related to a rhamnose methyl group. Two methoxy singlets at δ 3.78 (4'-OCH_3) and 3.97 ppm (6-OCH_3) were observed and they were confirmed by the 1D ^{13}C NMR signals at δ 55.6 (4'-OCH_3) and δ 60.3 ppm (6-OCH_3). Nine signals were observed in the ^{13}C NMR in the range of δ 66.0-76.5 ppm, corresponding to two sugar units: D-glucose and L-rhamnose as confirmed by 2D HMBC and HSQC-TOCSY experiments. The methyl group of rhamnose gave a signal at δ 17.8 ppm in the ^{13}C spectrum. Acid hydrolysis of the isolated substance yielded an aglycone, pectolinarigenin, besides D-glucose and L-rhamnose which were confirmed by TLC. According to the coupling constant observed in the ^{1}H NMR spectrum, the configurations at the anomeric carbons of D-glucose and L-rhamnose were determined as β- (J = 1.1 Hz) and α-linkages (J = 4.00 Hz), respectively.

The chemical shifts of the carbon signals for D-glucose and L-rhamnose, indicated L-rhamnose as the terminal sugar. The C-6 glucose signal at δ 66.0 ppm indicated that the disaccharide should be rutinose (Moccelini et al. 2009). The DEPT experiment confirmed this signal for a methylene group. The linkage of the rutinosyl moiety to the oxygen atom attached to C-7 was confirmed by the HMBC correlation between the glucosyl H-1 (δ 5.12) and C-7 (δ 157.3). The ^{13}C NMR data also supported the attachment of the rutinosyl moiety to the oxygen at the 7-position of a flavone (Table I and Figure 1).

Direct correlations observed in the 2D HMBC maps confirmed the identification of this compound as pectolinarin (Figure 2). H-3 signal (δ 6.93 ppm) is recognized by ^2J coupling with C-2 and C-4 (δ 164.3 and 182.9 ppm, respectively) and by ^3J coupling with C-10 and C-1' (δ 105.4 and 122.8 ppm, respectively). H-8 (δ 6.94 ppm) is determined by ^2J coupling with C-7 and C-9 (δ 157.3, 152.9 ppm, respectively), ^3J with C-6 (δ 133.2 ppm) and ^4J with C-5 (δ 152.7) while H-6' H-2' (δ 8.04 ppm) showed ^3J coupling with C-2 and C-4' (δ164.3, 162.8, respectively). Similarly, H-3'H-5' (δ 7.17 ppm) showed ^2J coupling with C-4' (δ 162.8) and ^3J with C-1' (δ 122.8). The direct coupling between H-2'H-6' and H-3'H-5' was not observed in the HMBC spectrum. The direct correlation between the OCH_3 hydrogens (δ 3.78 ppm) and C-4' (δ 162.8 ppm) confirmed the position of this methoxyl group at C-4'. Similar correlations were observed between the methoxyl group signal at 3.87 ppm

TABLE I
^{13}C and ^{1}H NMR data for pectolinarin in DMSO-d6.

Position	Type	δC ppm	δH ppm (*M, J*)
2	C	164.3	-
3	CH	103.5	6.93 (*s*)
4	C	182.9	-
5	C	152.7	-
6	C	133.2	-
7	C	157.3	-
8	CH	94.3	6.94 (*s*)
9	C	152.1	-
10	C	105.4	-
-	-	-	12.96 (*s*, 5-OH)
1’	C	122.8	-
2’	CH	128.4	8.04 (*d*, *J* = 8.0 Hz)
3’	CH	114.8	7.17 (*d*, *J* = 8.0 Hz)
4’	C	162.8	-
5’	CH	114.8	7.17 (*d*, *J* = 8.0 Hz)
6’	CH	128.4	8.04 (*d*, *J* = 8.0 Hz)
6-OCH_3	CH_3	60.3	3.87 (*s*)
4’-OCH_3	CH_3	55.6	3.78 (*s*)
1”	CH	100.4	5.12 (*d*, *J* = 4.0 Hz)
2”	CH	73.2	3.33*
3”	CH	76.5	3.35*
4”	CH	69.5	3.18*
5”	CH	75.8	3.63*
6”	CH_2	66.0	3.89; 3.48 (*dd*)
1’”	CH	100.4	4.57 (*d*, *J* = 1.1 Hz)
2’”	CH	70.8	3.46*
3’”	CH	70.4	3.67*
4’”	CH	72.0	3.16*
5’”	CH	68.3	3.41*
6’”	CH_3	17.8	1.06 (*d*, *J* = 4.0 HZ)

M: Multiplicity, *J*: coupling constant
*Approximate shifts obtained by HSQC experiment.

and C-6 (down field at δ 133.2 ppm) (Figure 1) (Silverstein et al. 2007, Yim et al. 2003).

The ESI-MS spectrum showed an ion peak at m/z 623 $[M + H]^+$ and ion peaks at 645 $[M + Na]^+$ and 661 $[M + K]^+$, which are coherent with the molecular formula $C_{29}H_{34}O_{15}$ for the flavone, pectolinarin.

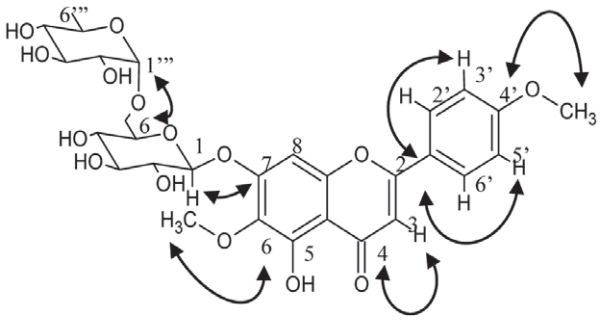

Fig. 2 - Main $^{1}H \rightarrow ^{13}C$ correlations inferred from HMBC pectolinarin spectra.

This is the first report on the occurrence of pectolinarin, a flavone, in the Bignoniaceae family. Earlier studies indicated some bioactivities of this flavone.

The antioxidant potential of seven Korean thistles rich in pectolinarin was evaluated via the peroxynitrite. The DPPH free radical assays exhibiting strong activity (Jeong et al. 2008). Pectolinarin isolated of the leaves of *Cirsium setidens* (Compositae), demonstrated hepatoprotective efficacy in a rat model of hepatic injury caused by D-galactosamine. It was suggested that the activity occurs mainly *via* SOD (superoxide dismutase) antioxidant mechanism (Yoo et al. 2008).

However, in the present study, pectolinarin has not presented any radical scavenging activity on the DPPH assay, although the LEE and the EtOAc:MeOH (1:1) fraction presented antioxidant activity by the DPPH assay (data not show). These results might be indicative of the presence of other phenols in LEE and EtOAc:MeOH (1:1) fraction which would be responsible for their antioxidant activity.

In vivo studies have demonstrated that oral administration of pectolinarin and a fraction rich in pectolinarigenin isolated from aerial parts of *Cirsium chanroenicum* at 20-100 mg/kg in several animal models resulted in inhibitory activities of inflammation/allergy: arachidonic acid-induced mouse ear edema, carrageenan-induced mouse

paw edema and passive cutaneous anaphylaxis. All of these results suggest that pectolinarigenin and pectolinarin possess anti-inflammatory activity and that they may inhibit eicosanoid formation in inflammatory lesions. These activities certainly contribute to the anti-inflammatory effects of *C. chanroenicum* (Lim et al. 2008).

The promising application of pectolinarin in the osteogenesis imperfecta (OI) type I pharmacological therapy was shown by *in vitro* tests. The flavonoid normalized collagen synthesis in OI cells. It was suggested that it exerts its effects through ß1-integrin-mediated signaling (Galicka and Nazarruk 2007).

In vitro studies have demonstrated that leaves ethanol extract of *D. elongate* and pectolinarin isolated from the same species have antiviral activity against vaccinia virus Western Reserve (VACV-WR) and dengue virus 2 (DENV-2) (Simões et al. 2011).

Although no ethnomedical use is reported for *D. elongata*, it might be considered useful as a source of pectolinarin for its disclosed antiviral, anti-inflamatory and collagen inducing synthesis effects.

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RESUMO

Pectolinarina, uma flavona heterosídica, foi isolada do extrato etanólico das folhas de *Distictella elongata* (Vahl) Urb., além de uma mistura de ácidos ursólico, pomólico e oleanólico, além de β-sitosterol. Suas estruturas foram estabelecidas com base em análise espectral (RMN de ^{1}H e ^{13}C 1D e 2D) em comparação com a literatura. Esta é a primeira vez em que se relata a ocorrência deste flavonoide em uma espécies da família Bignoniaceae.

Palavras-chave: Bignoniaceae, *Distictella elongata*, pectolinarina, triterpenos.

REFERENCES

BEDIR E, PEREIRA AMS, KHAN SI, CHITTIBOYINA A, MORAES RM AND KHAN IA. 2009. A New b-Lapachone Derivative from *Distictella elongata* (Vahl) Urb. J Braz Chem Soc 20: 383-386.

CASTILHO RO AND KAPLAN MAC. 2008. Constituintes químicos de *Licania tomentosa* Benth. Chrysobalanaceae. Quim Nova 31: 66-69.

CIPRIANI FA, CIDADE FW, SOARES GLG AND KAPLAN MAC. 2007. Similaridade Química entre as Tribos de Bignoniaceae. Rev Bras Bioc 5: 612-614.

GALICKA A AND NAZARRUK J. 2007. Stimulation of collagen biosynthesis by flavonoid glycosides in skin fibroblasts of osteogenesis imperfecta type I and the potential mechanism of their action. Int J Mol Med 20: 889-895.

HERTOG MGL, HOLLMAN PCH AND VENEMA DP. 1992. Optimization of a quantitative HPLC determination of potentially anticarcinogenic flavonoids in vegetables and fruits. J Agric Food Chem 40: 1591-1598.

JEONG DM, JUNG HA AND CHOI JS. 2008. Comparative antioxidant activity and HPLC profiles of some selected Korean thistles. Arch Pharmacal Res 31: 28-33.

LIM H, SON K, CHANG HW, BAE K, KANG SS AND KIM HP. 2008. Anti-inflammatory Activity of Pectolinarigenin and Pectolinarin Isolated from *Cirsium chanroenicum*. Biol Pharm Bull 31: 2063-2067.

LOHMANN LG. 2006. Untangling the phylogeny of neotropical lianas (Bignonieae, Bignoniaceae). Am J Bot 93: 304-318.

LOHMANN LG. 2010. Bignoniaceae in Lista de Espécies da Flora do Brasil. Jardim Botânico do Rio de Janeiro. (http://floradobrasil.jbrj.gov.br/2010/FB112456).

MABRY TJ, MARKHAM KR AND THOMAS MB. 1970. The Systematic Identification of Flavonoids; New York: Springer, 334 p.

MAHATO SB AND KUNDU AP. 1994. 13C NMR Spectra of pentacyclic triterpenoids–a complication and some salient features. Phytochemistry 37: 1517-1573.

MARKHAM KR. 1982. Techniques of flavonoid identification. London: Academic Press, 113 p.

MOCCELINI SK, SILVA VC, NDIAYE EA AND SOUSA JR PT. 2009. Estudo fitoquímico das cascas das raízes de *Zanthoxylum rigidum* Humb. & Bonpl. ex Willd (Rutaceae). Quim Nova 32: 131-133.

POOL A. 2009. A Review of the Genus *Distictella* (Bignoniaceae). Ann Miss Bot Garden 96: 286-323.

SILVERSTEIN RM, WEBSTER FX AND KIEMLE DJ. 2007. Identificação espectrométrica de compostos orgânicos. Rio de Janeiro: LTC, 490 p.

SIMÕES LR, MACIEL GM, BRANDÃO GC, KROON EG, CASTILHO RO AND OLIVEIRA AB. 2011. Antiviral activity of *Distictella elongata* (Vahl) Urb. (Bignoniaceae), a potentially useful source of anti-dengue drugs from the state of Minas Gerais, Brazil. Lett Appl Microbiol 53: 602-607.

WAGNER H, BLADT S AND ZGAINSKI EM. 1984. Plant drug analysis: a thin layer chromatography atlas. Berlim: Springer Verlag, 320 p.

YIM SH, KIM HJ AND LEE IS. 2003. A polyacetylene and flavonoids from *Cirsium rhinoceros*. Arch Pharmacal Res 26: 128-131.

YOO Y, NAM J, KIM M, CHOI J AND PARK H. 2008. Pectolinarin and Pectolinarigenin of *Cirsium setidens* Prevent the Hepatic Injury in Rats Caused by D-Galactosamine via an Antioxidant Mechanism. Biol Pharm Bull 31: 760-764.