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Short communication

# Lignans, cyclolignans and neolignans from the leaves of *Boscia senegalensis* (Pers.) Lam. ex Poir.

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The genus *Boscia* (Capparaceace) contains more than 37 species mainly distributed in Africa, except for one species that occurs in southern Arabia (Palmer and Pitman, 1972). *Boscia senegalensis* (Pers.) Lam. ex Poir. is an evergreen shrub reaching up to 4 m in height (Neuwinger, 1996). It is native to the Sahel and Sahara savannas.

Dried leaves of *B. senegalensis* were purchased from a folk medicine market from, Elobied, North Kordofan, Sudan, in March 2013. The plant material was identified by Professor A. M. Hamdoun, Faculty of Agricultural Sciences, University of Gezira, Sudan. A voucher specimen (CNU 13111) was deposited at the herbarium, College of Pharmacy, Chungnam National University, Daejeon, Republic of Korea.

## 1. Previous studies

There are limited studies about the taxonomic classification of *B. senegalensis.* Previous phytochemical studies on *B. senegalensis* which were conducted on the leaves and fruits identified glucosinolate (methyl, 2-propyl, and 2-butyl-glucosinolate) (Kjær et al., 1973), flavonol glycosides, megastigmane, monoterpenes, and phenolic compounds (Morgan et al., 2014). However, to our knowledge, there are no reports on the lignan composition of *B. senegalensis*.

## 2. Present study

The present study describes the isolation and identification of compounds **1**–**8** (Fig. 1) from *B. senegalensis*.

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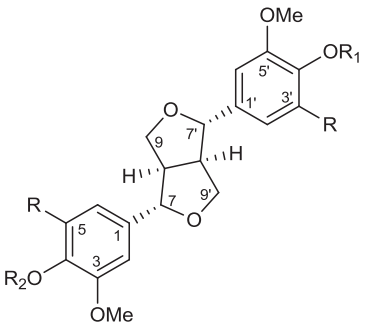
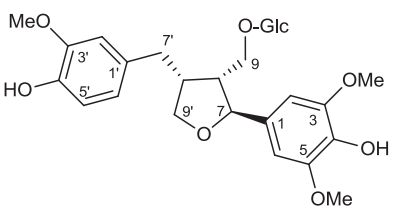


| | R | $R_1$ | $R_2$ |
|---|---|---|---|
| **1** | OMe | H | Me |
| **2** | H | H | Glc |
| **3** | OMe | Glc | Glc |



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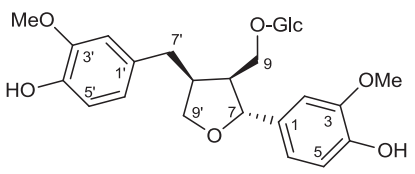

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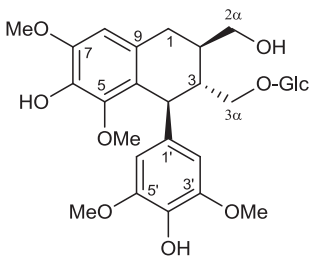

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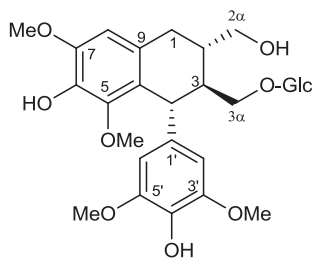

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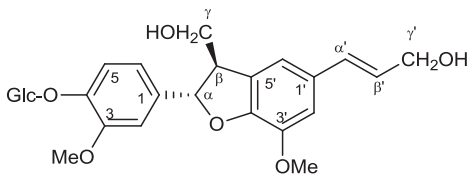

**8**

**Fig. 1.** Chemical structures of compounds **1**–**8** from *B. senegalensis*.

Dried leaves of *B. senegalensis* (3.0 kg) were extracted with 100% hot methanol under reflux conditions (three times). After removing the solvent under reduced pressure, the MeOH extract (580 g) was suspended in water (1.0 L), and successively partitioned with $CH_2Cl_2$ and EtOAc, to give 85 g of $CH_2Cl_2$ extract and 20 g of EtOAc extract, and 475 g of aqueous extract, respectively. Aqueous extract was chromatographed on a column of Diaion HP-20 using a stepwise gradient of $H_2O$ and MeOH (0%, 25%, 50%, 75% and 100% MeOH in $H_2O$) to give five fractions (Fractions W1–W5). Fraction W3 was repeatedly separated by silica gel (70–230 mesh) column chromatography eluted with $CH_2Cl_2$/MeOH/$H_2O$ (15:1:0.1–1:1:0.1, v/v/v) and $CHCl_3$/MeOH/$H_2O$ (6.5:1:0.1, v/v/v) to obtain **4** (55 mg), **5** (30 mg), **6** (20 mg), and **7** (23 mg). Fraction W4 was subjected to silica gel (70–230 mesh) column chromatography eluted with $CH_2Cl_2$/MeOH/$H_2O$ (20:1:0.1–1:1:0.1, v/v/v) to afford three sub-fractions (W4a–W4c). Sub-fraction W4a was separated by a YMC gel column chromatography (RP-C18 resin 30–50 μm) eluting with MeOH/$H_2O$ (0.6:1–0.7:1, v/v) to afford **1** (25 mg). Sub-fraction W**4c** was separated by a YMC gel column chromatography (RP-C18 resin 30–50 μm) eluting with MeOH/$Me_2CO$/$H_2O$ (0.3:0.3:1, v/v/v), followed by silica gel column chromatography with $CHCl_3$/MeOH/$H_2O$ (6.5:1:0.1, v/v/v) to obtain **2** (28 mg) and **3** (17 mg). Compounds **8** (20 mg) was obtained from the fraction W5 by silica gel (70–230 mesh) chromatography eluted with $CH_2Cl_2$/MeOH/$H_2O$ (12:1:0.1–1:1:0.1, v/v/v), followed by a YMC gel column chromatography eluted with MeOH/$Me_2CO$/$H_2O$ (0.3:0.3:1, v/v/v).

The chemical structures of compounds **1**–**8** were determined by spectroscopic data and by comparison with previously published data (Fig. 1). Their structures were elucidated as 4'-hydroxy-3,3′,4,5,5'-pentamethoxy-7,9':7′,9-diepoxylignane (**1**) (Liang et al., 2011), pinoresinol-4′-*O*-*β*-D-glucopyranoside (**2**) (Ouyang et al., 2007), liriodendrin (**3**) (Takeshi, 1983), Alangilignoside D (**4**) (Kaori et al., 1997), (+)-lariciresinol-9-*O*-*β*-D-glucopyranoside (**5**) (Ling et al., 2004), (+)-lyoniresinol-3*α*-*O*-*β*-D-glucopyranoside (**6**) (Achenbach et al., 1992), (−)-lyoniresinol-3*α*-*O*-*β*-D-glucopyranoside (**7**) (Achenbach et al., 1992), and dehydrodiconiferyl alcohol-4-*O*-*β*-D-glucopyranoside (**8**) (Mohamed et al., 2007).

## 3. Chemotaxonomic significance

Plants of the family Capparaceace are known to be rich in thioglucosides (known as glucosinolates) which release isothiocyanates (mustard oils) when the plants are damaged (Mitchell, 1974; Mitchell et al., 1974; Richter, 1980). Alkaloids also were isolated from leaves of 33 of 37 species and L-stachydrine and L- 3- hydroxystachydrine were the major components present. These alkaloids characterize the family Capparaceace in the same way as do the glucosinolates (Pierre et al., 1973).

The present study reported the isolation and identification of eight compounds with lignan skeletons: three diepoxylignans (**1**–**3**), two epoxylignans (**4**, **5**), two cyclolignans (**6**, **7**), and one neolignans (**8**). This is the first report of lignan compounds from species of *Boscia*. The isolation of lignan may have chemotaxonomic importance for *B. senegalensis*. Flavonoids, phenolic compounds and megastigmen have been reported from the leaves of *Boscia salicifolia* and *B. senegalensis* (Angelika et al., 1990; Niklaus et al., 1990; Morgan et al., 2014). Alkaloids have also been reported from the leaves, bark, and roots of *Boscia angustifolia* (Caterina et al., 1992; Hassan et al., 2006). Diepoxylignans, epoxylignans, cyclolignans, and neolignans were previously isolated from *Capparis flavicans*, *Capparis tenera*, and *Maerua crassifolia* (Capparaceae) (Bishay et al., 1990; Su et al., 2007; Luecha et al., 2009). Compound **1** has been isolated from *Sinocalamus affinis* (Poaceae) (Liang et al., 2011), and compounds **2** and **8** from *Arabidopsis thaliana* (Brassicaceae) (Floerl et al., 2012), however, compound **3** has been recorded from *Eucommia ulmoides* (Eucommiaceae) (Takeshi, 1983). Compound **4** was found in *C. flavicans* (Capparaceae) (Luecha et al., 2009), and compound **5** was found in *Rorippa indica* (Brassicaceae) (Lin et al., 2014). Compounds **6** and **7** were reported for the first time from *Stemmadenia minima* (Apocynaceae) and *Maerua crassifolia* (Capparaceae) (Bishay et al., 1990; Achenbach et al., 1992). Moreover compounds **3, 6, 7,** and **8** have been also reported in *Cestrum diurnum* (Solanaceae) (Mohamed et al., 2007). The presence of compounds **2**, **5** and **8** in both the Capparaceae and the Brassicaceae family may imply a close relationship between the two families (Hall et al., 2002). Moreover, the occurrence of compounds **6** and **7** in the genus *Boscia* and the genus *Maerua* is in agreement with the conclusion that taxonomically *Boscia* and *Maerua* are closely related genus.

As this is the first report of these compounds from *Boscia* they might be of chemotaxonomic significance for the genus *Boscia* species, especially the diepoxylignans (**1**–**3**), epoxylignans (**4, 5**), and neolignans (**8**).

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## References

Achenbach, H., Lowel, M., Waibel, R., Gupta, M., Solis, P., 1992. Planta Medica 58, 270.
Angelika, W., Urs, S., 1990. Phytochemistry 29, 2561.
Bishay, D.W., Abdel-Baky, A.M., Ramadan, M.A., Ibrahim, Z.Z., Itokawa, H., Takeya, K., 1990. Bull. Pharm. Sci. 13, 39.
Caterina, C., Anna Rita, B., Arouna, K., Ivano, M., 1992. Planta Medica 58, 476.
Floerl, S., Majcherczyk, A., Possienke, M., Feussner, K., Tappe, H., Gatz, C., Feussner, I., Kues, U., Polle, A., 2012. PLoS One 7, e31435.
Hall, J.C., Sytsma, K.J., Iltis, H.H., 2002. Am. J. Bot. 89, 1826.
Hassan, S.W., Umar, R.A., Lawal, M., Bilbis, L.S., Muhammad, B.Y., Dabai, Y.U., 2006. Afr. J. Biotechnol. 5, 1602.
Kaori, Y., Toshinori, I., Hideaki, O., Choei, O., Eiji, H., Anki, T., Yoshio, T., 1997. Phytochemistry 45, 611.
Kjær, A., Schuster, A., Delaveau, P., Koudogbo, B., 1973. Phytochemistry 12, 725.
Liang, X., Chenggeng, Z., Yanru, L., Ye, T., Sheng, L., Shaopeng, Y., Jinfeng, H., Qi, H., Naihong, C., Yongchun, Y., Jiangong, S., 2011. J. Nat. Prod. 74, 1188.
Ling, S.K., Takashima, T., Tanaka, T., Fujioka, T., Mihashi, K., Kouno, K., 2004. Fitoterapia 75, 785.
Lin, L.Z., Sun, J., Chen, P., Zhang, R.W., Fan, X.E., Li, L.W., Harnly, J.M., 2014. J. Agric. Food Chem. 62, 6118.
Luecha, P., Umehara, K., Miyase, T., Noguchi, H., 2009. J. Nat. Prod. 72, 1954.
Mitchell, J.C., 1974. Br. J. Dermatol. 91, 13.
Mitchell, J.C., Jordan, W.P., 1974. Br. J. Dermatol. 91, 183.
Mohamed, K.M., Fouad, M.A., Matsunami, K., Kamel, M.S., Otsuka, H., 2007. ARKIVOC xiii, 63.
Morgan, A.M.A., Kim, J.H., Kim, S.K., Lim, C.H., Kim, Y.H., 2014. Bull. Korean Chem. Soc. 35, 3447.
Neuwinger, H.D., 1996. Capparidaceae. In: Neuwinger, H.D. (Ed.), African Ethnobotany: Poisons and Drugs: Chemistry, Pharmacology, Toxicology. Chapman and Hall/CRC Press, Weinham, Germany, p. 327.
Niklaus, P., Urs, S., Angelika, W., 1990. Helvetica Chim. Acta 73, 578.
Ouyang, M.A., Wein, Y.S., Zhang, Z.K., Kuo, Y.H., 2007. J. Agric. Food Chem. 55, 6460.
Palmer, E., Pitman, N., 1972. Trees of Southern Africa. A. A. Balkema, Press, Cape Town, South Africa, p. 118.
Pierre, D., Blaise, K., Pousset, B., 1973. Phytochemistry 12, 2893.
Richter, G., 1980. Contact Dermat. 6, 183.
Su, D.M., Wang, Y.H., Yu, S.S., Yu, D.Q., Hu, Y.C., Tang, W.Z., Liu, G.T., Wang, W.J., 2007. Chem. Biodivers. 4, 2852.
Takeshi, D., 1983. Chem. Pharm. Bull. 31, 2993.