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FLAVANOIDS ISOLATED FROM THE BARKS OF *FAIDHERBIA ALBIBA* (DELILE) A. CHEV

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ABSTRACT

Faidherbia albida Del. (Leguminosae), is a plant of the Senegal traditional pharmacopoeia whose leaves and bark are used in the treatment of various diseases. Investigation on *Faidherbia albida* Del. resulted in the isolation two glycosyl flavones **1** and **2**. The isolated compounds were characterized by NMR and mass-spectrometry. The present study constitutes the first phytochemical examination of the barks of *Faidherbia albida* Del.

KEYWORDS: *Faidherbia albida* (Delile) A. Chev; barks; glucoflavans, GC/MS, LC-MS, NMR (1D, 2D).

1. INTRODUCTION

Faidherbia albida known for its numerous therapeutic virtues is a plant of the traditional Senegalese pharmacopoeia. Little's known about the chemistry most species the genus's Acacia, although the genus is widespread in hot, arid parts of the world.[1-5] Taxonomy and identification of Acacia species is difficult.[6,7] New studies the kind have confirmed that the Acacia's an agglomeration at least five distinct groups. The main elements this genus are the groups now recognized as the subgenus Acacia, of the genus *Faidherbia*, the subgenus '*Aculeiferum*', close to *Acacia coulteri*, series of *Bentham Filicinae*, of the subgenus *Phyllodineae* and possibly others.

A number of secondary metabolites have been reported in various species of Acacia, including amines and alkaloids, cyanogenic glycosides, cyclitols, fatty acids and seed oils, fluoroacetate, gums, non-protein amino acids, terpenes (including oils essential, diterpenes, phytosterol and triterpene as well as genins and saponins), hydrolyzable tannins, flavonoids and condensed tannins.[8-10] The most obvious and well-known are complex phenolic substances (condensed tannins) and polysaccharides (gums).[11-15] We present for the first time in this study the isolation and characterization of secondary metabolites present in the ethyl acetate extract of *Faidherbia* bark in order to understand the therapeutic activity of this plant.

2. MATERIALS AND METHODS

2.1. *Plant Material*

Barks of *Faidherbia albida* were collected in April 2016 Bambey, Senegal. The plant was authenticated by Laboratoire de Botanique de l'Institut Fondamental de l'Afrique Noire, University Cheickh Anta Diop, Dakar, Senegal. A voucher specimen was deposited at the herbarium the Pharmacognosy and botany laboratory under number 2016/020.

2.2. *Extraction and Isolation*

The powdered barks (400 g) of *Faidherbia albida* were macerated in 2 L H_2O and 50mL H_2SO_4 (5%) for a week. After filtration, washing with ethyl ether is performed to remove nonionic polar compounds. The aqueous phase is neutralized with 50 mL NaOH (10%), then extracted successively with 600 ml of hexane (55 g), 600 ml of ethyl acetate (115g) and 600 mL of chloroform (128 g). Part of the crude ethyl acetate extract (100 mg) is purified by preparative thin layer chromatography. After eluting the acetate ethyl extract (207 mg) with a mixture of CH_2Cl_2/ MeOH (80/20 v/v 200 mL), four fractions were collected. Compounds 1 (19 mg) and 2 (7 mg) were isolated.

2.3. Experimental Section

The optical rotation was measured with an electronic Polarimeter Perkin Elmer 241. IR spectra were recorded on a spectrometer Nicolet Avatar 320 FT-IR. UV spectra were obtained by using a Philips PU 8720 UV/VIS spectrophotometer. ^{1}H and ^{13}C-NMR spectra were recorded on a Bruker Avance DRX- 400 spectrometer,

operating at 400 MHz for ^{1}H and 125 MHz for ^{13}C. Coupling constants were expressed in Hz. High resolution mass spectra (HRESIMS) and ESIMS (positive-ion mode) were recorded using Micromass ESI-Q-TOF micro-instrument (Manchester, UK). Analytical and preparative TLC were performed on pre-coated kieselgel 60 F254 plates 250 µm (Merck) using CH_2Cl_2/MeOH (80/20) is eluent and detected by spraying with Dragendorff or H_2SO_4 (20%) followed by heating.

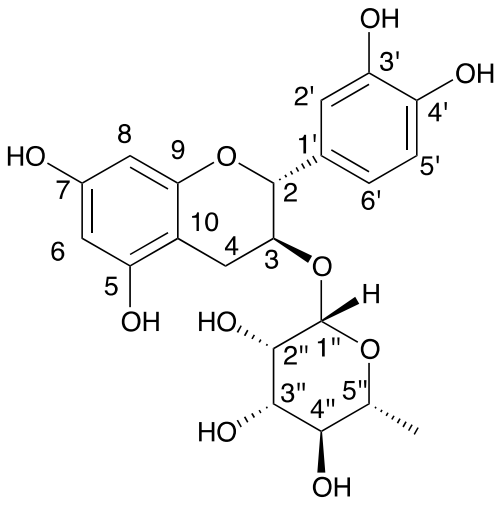
3. RESULTS

Purification of the acetate extract by TLC preparative isolated two glucoflavannoids. The results of the analysis of the spectra of ^{1}H, of ^{13}C, of COSY ^{1}H-^{1}H and of HSQC are recorded in tableaux **1** and **2**.

Table 1: Summary table of the analysis of the NMR spectra of molecule 1.

Carbone N°	^{13}C, ppm	^{1}H, mult. (J en Hz), ppm	Corrélations COSY	Corrélations HSQC
2	78	4.61; d (7.86)	H_3 ; H_2	H_2
3	68	3.92dd (7.86 ; 8.16)	H_3 ; $H_{4\square}$; $H_{4\square}$	H_3
4	26	$H_{4\square}$: 2.87 ; dd (10.57 ; 8.16) $H_{4\square}$: 2.63 ; dd (10.57 ; 8.16)	H_3 ; $H_{4\square}$ H_3 ; $H_{4\square}$	$H_{4\square}$ et $H_{4\square}$
5	160,2			
6	93	5.84 ; s		H_6
7	165,2			
8	94	5.93 ; s		H_8
9	156,4			
10	104,7			
1'	125,5			
2'	104	6.83 ; s		$H_{2'}$
3'	145,8			
4'	141,5			
5'	115	6.76 ; dd (8.2 ; 1.2)	$H_{6'}$; H_5'	$H_{5'}$
6'	119	6.70; d (8.2)	H_5' ; $H_{6'}$	$H_{6'}$
1''	74	4.28; d(8.25)	$H_{2'}$	$H_{1''}$
2''	72	3.38 ; dd(8.25 ;8.25)	$H_{1''}$; $H_{2''}$	$H_{2''}$
3''	71	3.50 ; dd(9.6 ; 8.25)	$H_{2''}$; $H_{3''}$	$H_{3''}$
4''	47	3.28 ; dd(9.38 ; 9.6)	$H_{3''}$; $H_{4''}$	$H_{4''}$
5''	70	3.57 ; m(9.38 ; 9.53)	$H_{4''}$; $H_{5''}$	$H_{5''}$
Me-5''	16	1.24 ; d(9.53)	$H_{5''}$; H_{Me}	3H

The spectral analyzes led us to propose the following structure of the (+) Catechin-3-O-α-L-rhamnopyranoside **1**.



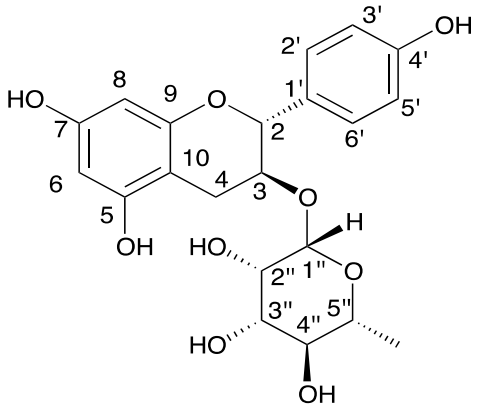
1

Figure 1: (+) Catechin-3-O-α-L-rhamnopyranosides (1)

Table 2: Summary table of the analysis of the NMR spectra of molecule 2.

Carbone N°	$\delta^{13}C$, mult. ppm	$\delta^{1}H$, mult. (J en Hz), ppm	Corrélations COSY	Corrélations HSQC
2	82	4.56; d (8.06); 1H	H_2 ; H_3	H_2
3	70	3.92; m (9.49) ; 1H	H_3 ; H_2	H_3
4	28	$H_{4\alpha}$: 2.90; dd (5.71, 16); 1H $H_{4\beta}$: 2.64; dd (8.68, 16); 1H	H_3 ; $H_{4\alpha}$ H_3 ; $H_{4\beta}$	$H_{4\alpha}$ et $H_{4\beta}$
5	160.2			
6	97	5.84; s		H_6
7	165.2			
8	99	5.93; s		H_8
9	157.3			
10	105.1			
1'	126.4			
2'	119	6.77; d (8.54); 1H	$H_{3'}$; $H_{2'}$	$H_{2'}$
3'	134	7.22 ; d (8.54) ; 1H	$H_{2'}$; $H_{3'}$	$H_{3'}$
4'	157.5			
5'	134	7.22; d (8.54) ; 1H	$H_{6'}$; $H_{5'}$	$H_{5'}$
6'	119	6.77; d (8.54) ; 1H	$H_{5'}$; $H_{6'}$	$H_{6'}$
1''	76	4.23; d (8.25) ; 1H	$H_{1''}$; $H_{2''}$	$H_{1''}$
2''	74	3.36; dd (8.25; 8.25)	$H_{1''}$; $H_{2''}$	$H_{2''}$
3''	71	3.46; dd (9.6; 8,25)	$H_{2''}$; $H_{3''}$	$H_{3''}$
4''	49	3.28; dd (9.38; 9.6)	$H_{3''}$; $H_{4''}$	$H_{4''}$
5''	72	3.57; m (9.38, 9.53) 1H	$H_{4''}$; $H_{5''}$	$H_{5''}$
Me-5''	17	1.75 ; d (9.53)	$H_{5''}$; H_{Me}	3H

The spectral analyzes led us to propose the following structure of the (+)-Afzelechin 3-O-α-L-rhamnopyranoside **2**.



2

Figure 2: (+)-Afzelechin 3-O-α-L-rhamnopyranoside (2)

4. DISCUSSION

This study describes the extraction, isolation and characterization of glycosyl flavones from the barks of *Faidherbia albida* Del. Preparative TLC of extracts ethyl acetate (115mg) of the barks of *Faidherbia albida* Del led to the isolation of the two major glycosyl flavones. These purified compounds were then submitted to ^{1}H and ^{13}C NMR spectroscopy, and were identified, respectively, as (+) Catechin-3-O-α-L-rhamnopyranosides (1) and as (+)-Afzelechin 3-O-α-L-rhamnopyranosides (2), on the basis of a comparison of the spectral data to those previously reported in the literature and were confirmed though the co-elution with commercial standards[16-28] (Figure 3).

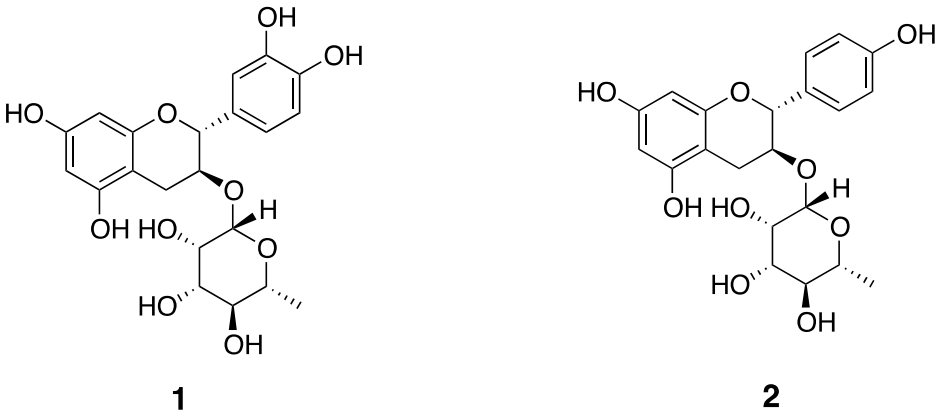


Figure 3: Structure of the isolated molecules: (+) Catechin-3-O-α-L-rhamnopyranosides (1) and (+)-Afzelechin 3-O-α-L-rhamnopyranosides (2)

Studies have shown the antidiabetic and antioxidant activity of glycosyl flavones.[26,28] Thus, the ethnomedical use of barks of *Faidherbia albida* Del. for the treatment of various diseases in the Senegalese pharmacopoeia could be attributed to the presence of these secondary metabolites observed.

5. CONCLUSION

This article reports for the first time the phytochemical investigation on the barks of Faidherbia albida. Two glycosyl flavones isolated from ethyl acetate extract and characterized by NMR, GC / MS and LC / MS. These results could justify the use bark in traditional medicine to treat various diseases. Thus, this study supports the ethno-medicinal use of plants in the treatment of associated symptoms. In our next studies, we intend to test the biological activity of these isolated molecules and to continue the purification of the other extracts.

Declaration of interest: The authors declare no conflicts of interest. The authors alone are responsible for the content of this manuscript.

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REFERENCES

1. Dey PM, Harborne JB. Plant Biochemistry, book Academic Press, 1997; 1-529.
2. Grisebach H. Anthocyanins as food colors, Ed. P. Markakis Press, New York, 1982.
3. Bruneton J. Pharmacognosie-phytochimie, plantes médecin ales, 4éme éd, revue et augmentée, Paris, Tec et Doc-Edition médicinales internationales, 2009; 1289.
4. Berhaut J. La Flore illustrée du Sénégal. Préf. de L. Sédar Senghor JATBA, 1974; 21(7): 269-270.
5. Kerharo J, Adam J.G. La pharmacopée sénégalaise traditionnelle, Plantes médicinales et toxiques, 1974.
6. Kerharo J, Adam J.G. La pharmacopée sénégalaise traditionnelle, Plantes médicinales et toxiques, 1974.
7. CTFTICI RAD. *Faidherbia albida* (Del.) A. Chev. (Synonyme : Acacia albida Del.) : monographie CIRAD-CTFT - FRA. Nogent-sur-Marne : CIRAD-CTFT, 72 p. ISBN 2-85411-004-8., 1988.
8. Fadipe AL, Mann A, Dasaba V, Usman DO, Olajide P. Isolation of some nonpolar constituents from the fruits of Faidherbia albida (Del.) A. Chev., IJAPBC, 2015; 4(4): 767-774.
9. Mohammed M, Ahmed AA, Ezz-eldin KD, Lourin GG. Macro-and micromorphology of the leaf, stem bark and fruit of *faidherbia albida* (Del.) A. Chev. Cultivated in Egypt. Bull. Pharm. Sci., 2018; 41: 1-29.
10. Nanema SL, Nana R, Memti MN, Konate B, Badiel AB, Alain ID, Tamini Z. Les teneurs en phytohormones des organes aériens de *Faidherbia albida* (Del) A. Chevalier au cours de la période froide et sèche au Burkina Faso. J. Appl. Biosci, 2016; 107: 10395-10406.
11. Bernan JPM. Manual on taxonomy of acacia Species: present taxonomy of four species of acacia *(A. albida, A.sénégal, A.tortilis, A.séyal) FAO,* Rome, 1983.
12. Tendens A. Alkaloids- secrets of life, Alkaloids chemistry, Biological significance, Application and Ecological Rôle, Elsever, 2007.
13. Seigler DS. Phytochemistry of Acacia-sensu lato. Biochem. Syst. Ecol., 2003; 31: 845-873.
14. Tzong-Huei L, Feng Q, George R. Waller, and Chang-Hung Chou. Three New Flavonol Galloylglycosides from Leaves of Acacia confuse. J. Nat. Prod, 2000; 63: 710-712.
15. Shen D, Wu Q, Wang M, Yang Y, Lavoie EJ, Simon JE. Determination of the Predominant Catechins in Acacia catechu by Liquid Chromatography/Electrospray Ionization−Mass Spectrometry. J. Agric. Food Chem., 2006; 54: 3219−3224.

16. Manfred B, Hilmar F, Herbert K. (+)-catechin 3-rhamnoside from *Erythroxylum novogranatense*, *Pytochemistry*, 1986; 25(5): 1205-1207.
17. Yusuf AJ, Abdullahi MI, Musa AM, Haruna AK, Mzozoyana V, Abubakar H. Bioactive (+)-Catechin-3'-O-rhamnopyranoside from *Neocarya macrophylla* (Sabine) Prance (Chrysobalanaceae). EJBSA, 2019; 6(1): 124-126.
18. Jesus NSS, Evaldo MS, Milton N. daS, Mara SPA, Yvan L, Hervé R. Identification and Antioxidant Activity of Several Flavonoids of *Inga Edulis* Leaves. J. Braz. Chem. Soc., 2007; 18(6): 1276-1280.
19. Zebiri I, Sauvain M, Voutquenne-Nazabadioko L, Haddad M. Phytochemical study of four plants from the family Myrsinaceae. Planta Med, 2014; 80: S16.
20. Lorena RFS, da Silva JA, Cesar VP, Costa MB, Santos ML, Sbardelotto AB, Ó Pessoac C, de Moraesc MaO, Menezes ACS. Constituintes quimicos das cascas do caule de *Vochysia thyrsoidea Pohl* (Vochysiaceae) E avaliacao das atividades citotoxica E inibitoria frente as catepsinas B E K. Quim. Nova, 2014; 37(2): 288-292.
21. Furkan A, Laxminarain M, Tewari R, Gupta P, Gupta KVV et Mahendra P Darokar. Isolation and HPLC profiling of chemical constituents of *Saraca asoca* stem bark. Indian J. Chem., 2016; 55B: 353-361.
22. Siegfried E., Drewes Craig W., Taylor Anthony B., Cunningham, (+)-Afzelechin 3-rhamnoside from *Cassipourea gerrardii*, Phytochemistry, 1992; 31(3): 1073-1075.
23. Qamar UA, Alhassan MA, Alfi K, Syed AAS, Muhammad MH, Murni NS. Antiradical and Xanthine Oxidase Inhibitory Activity Evaluations of *Averrhoa bilimbi* L. Leaves and Tentative Identification of Bioactive Constituents through LC-QTOF-MS/MS and Molecular Docking Approach. Antioxidants, 2018; 7: 137- 140.
24. Yandri ST, Suwandi JF, Hadi S. Two Flavan Derivatives Isolated from Artocarpus dadah Grown in Lampung, Indonesia. Asian J. Chem., 2013; 25(2): 1050-1056.
25. Ping M, Xin Q, Shu P, Hong S, Guo-Fu Z, Ai-Jun H. New isoprenylated flavonoids and cytotoxic constituents from Artocarpus tonkinensis Jian. J. Asian Nat. Prod. Res., 2010; 12(7): 586–592.
26. Su BN , Cuendet M , Hawthorne ME, Kardono LB, Riswan S, Fong HH, Mehta RG, Pezzuto JM, Kinghorn AD . Constituents of the bark and twigs of Artocarpus dadah with cyclooxygenase inhibitory activity. J. Nat. Prod, 2002; 65(2): 163-169.
27. Marwa MM, Ali AA, Ezz-eldin KD, Gobraeil LG.Compounds isolation and in vitro antioxidant activity evaluation of Faidherbia albida (Del.) A. Chev. Leaves ethanolic extract. J. Pharmacogn. Phytochem, 2018; 7(2): 471-475.
28. Lee Suan Chua, Farah Izana Abdulah, Mohd Azrie Awang, Potential of natural bioactive C-glycosyl flavones for antidiabetic properties. Stud. Nat. Prod. Chem., 2020; 64: 241-261.