

**Isolation and characterization of novel acetylcholinesterase inhibitors from
Ficus benghalensis L. leaves**

Heba A. Hassan^a, Ahmed E. Allam^b, Dalia H. Abu-Baih^f, Mamdouh F. A. Mohamedⁱ, Usama R. Abdelmohsen^{a,d}, Kuniyoshi Shimizu^c, Samar Y. Desoukey^d, Alaa M. Hayallah^{g,h}, Mahmoud A. Elrehany^f, Khaled M. Mohamed^e, and Mohamed S. Kamel^{a,d}

^aDepartment of Pharmacognosy, Faculty of Pharmacy, Deraya University, Universities Zone, New Minia City 61111, Egypt

^bDepartment of Pharmacognosy, Faculty of Pharmacy, Al-Azhar University, Assiut 71524, Egypt

^cDepartment of Agro-Environmental Sciences, Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Fukuoka 819-0395, Japan

^dDepartment of Pharmacognosy, Faculty of Pharmacy, Minia University, Minia 61519, Egypt.

^eDepartment of Pharmacognosy, Faculty of Pharmacy, Fayoum University, Fayoum 63514, Egypt.

^fDepartment of Biochemistry and Molecular Biology, Faculty of Pharmacy, Deraya University, Universities Zone, New Minia City 61111, Egypt

^gDepartment of Pharmaceutical Chemistry, Faculty of Pharmacy, Deraya University, Universities Zone, New Minia City 61111, Egypt

^hDepartment of Pharmaceutical Chemistry, Faculty of Pharmacy, Assiut University, Assiut 71526, Egypt

ⁱDepartment of Pharmaceutical Chemistry, Faculty of Pharmacy, Sohag University, 82524 Sohag, Egypt.

Fig. S 1; ^1H NMR spectrum of compound 1

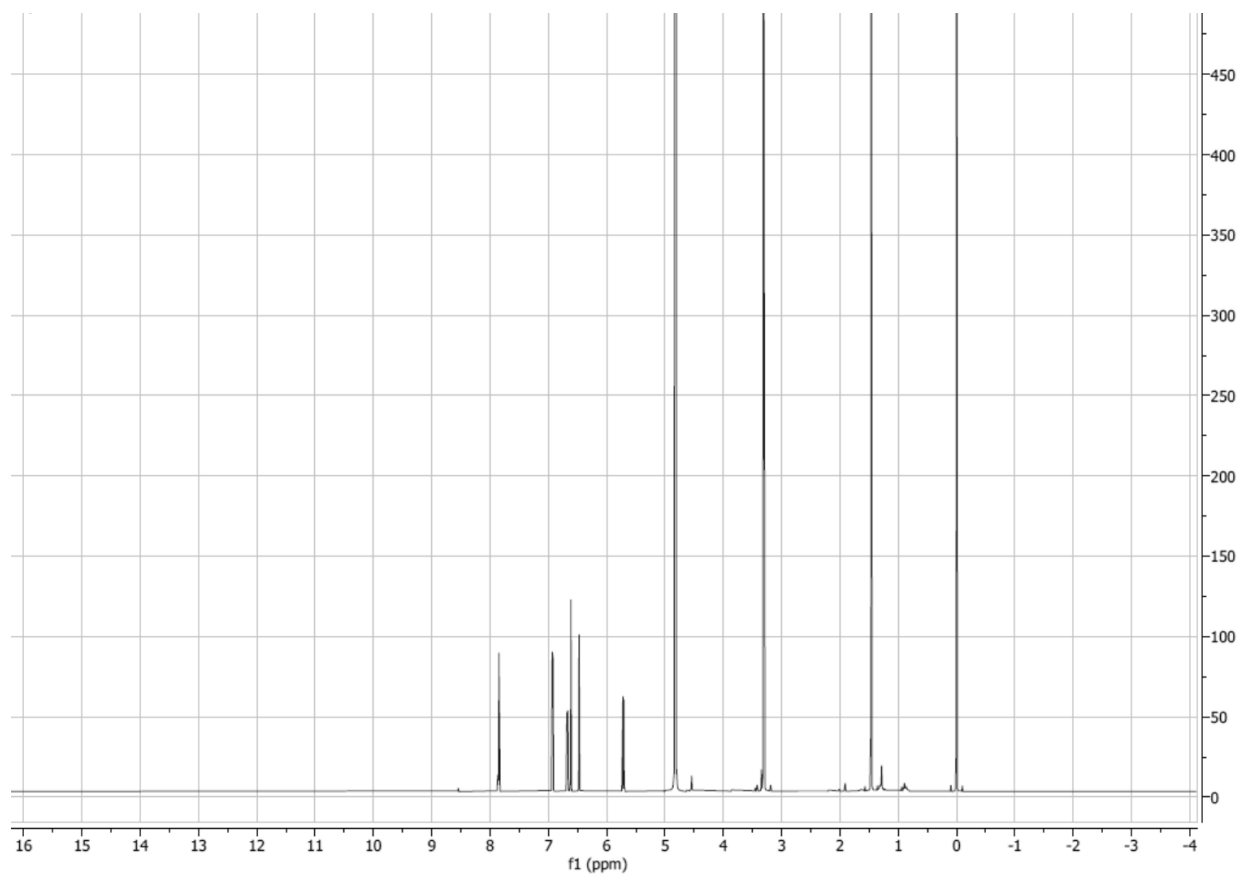


Fig. S 2; ^{13}C NMR spectrum of compound **1**

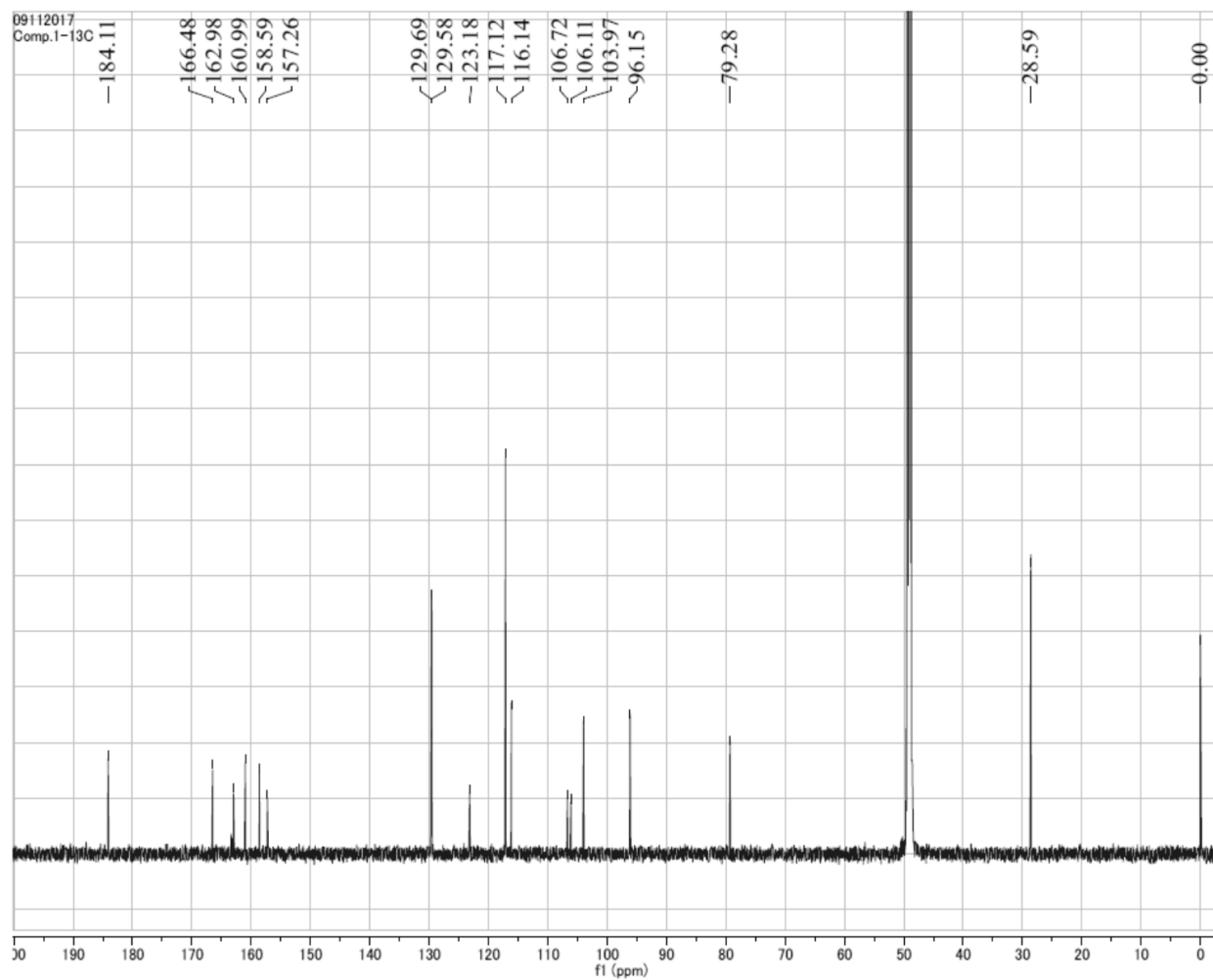


Fig. S 3; ^1H NMR spectrum of compound 2

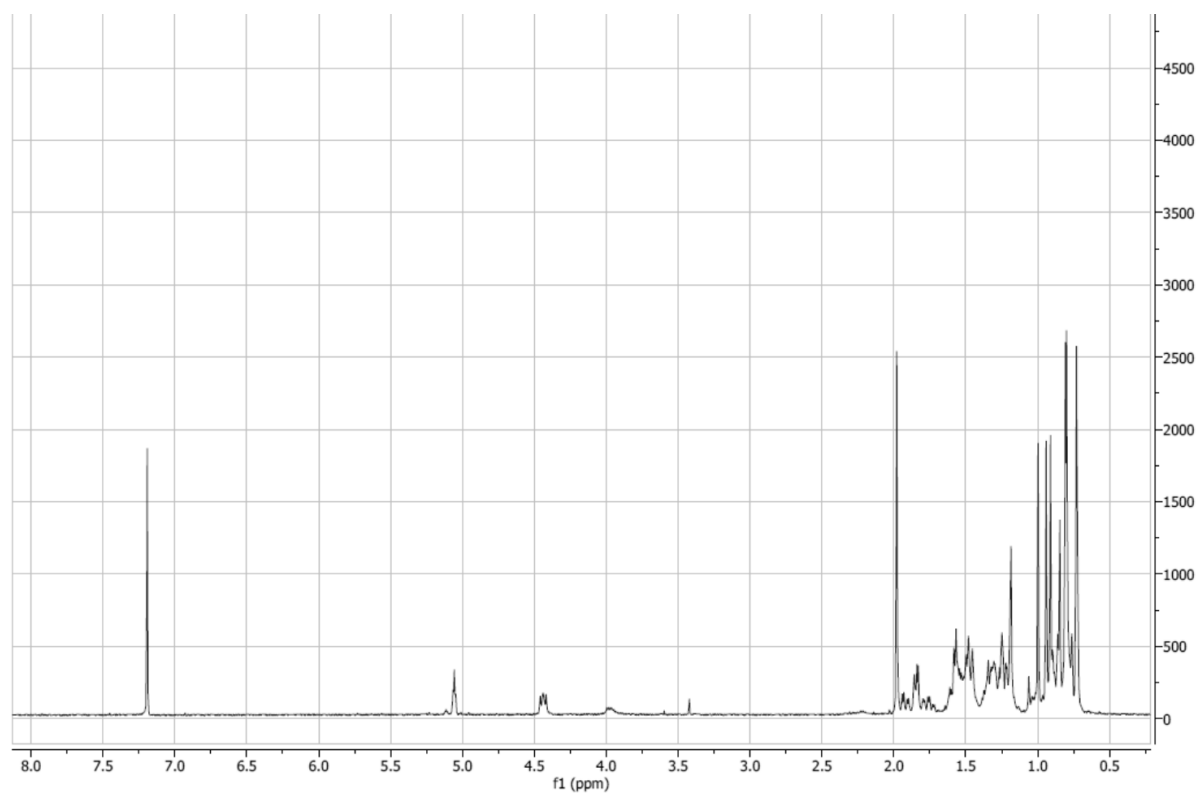


Fig. S 4; ^{13}C NMR spectrum of compound 2

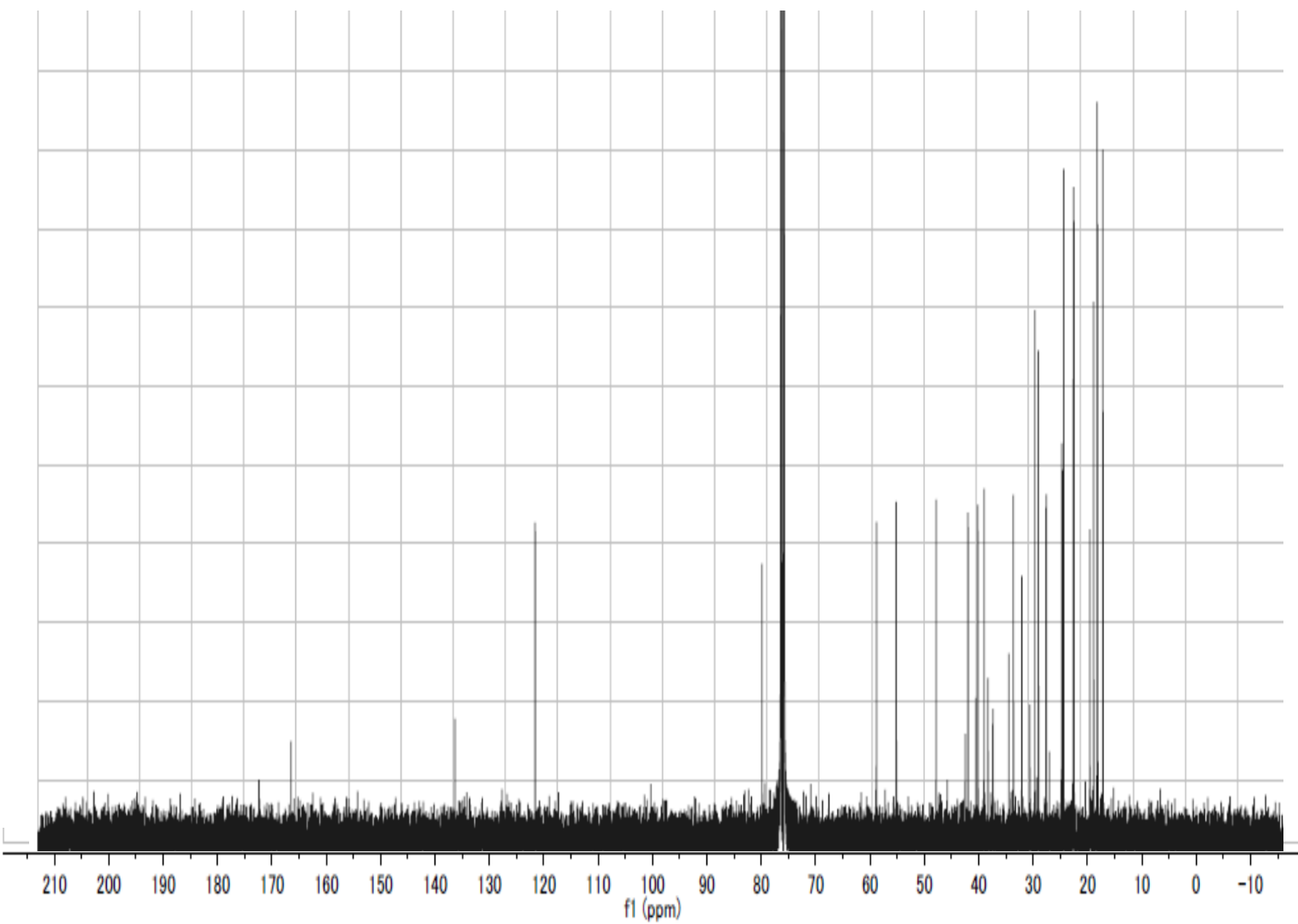


Fig. S 5; ^{13}C NMR spectrum of compound 3

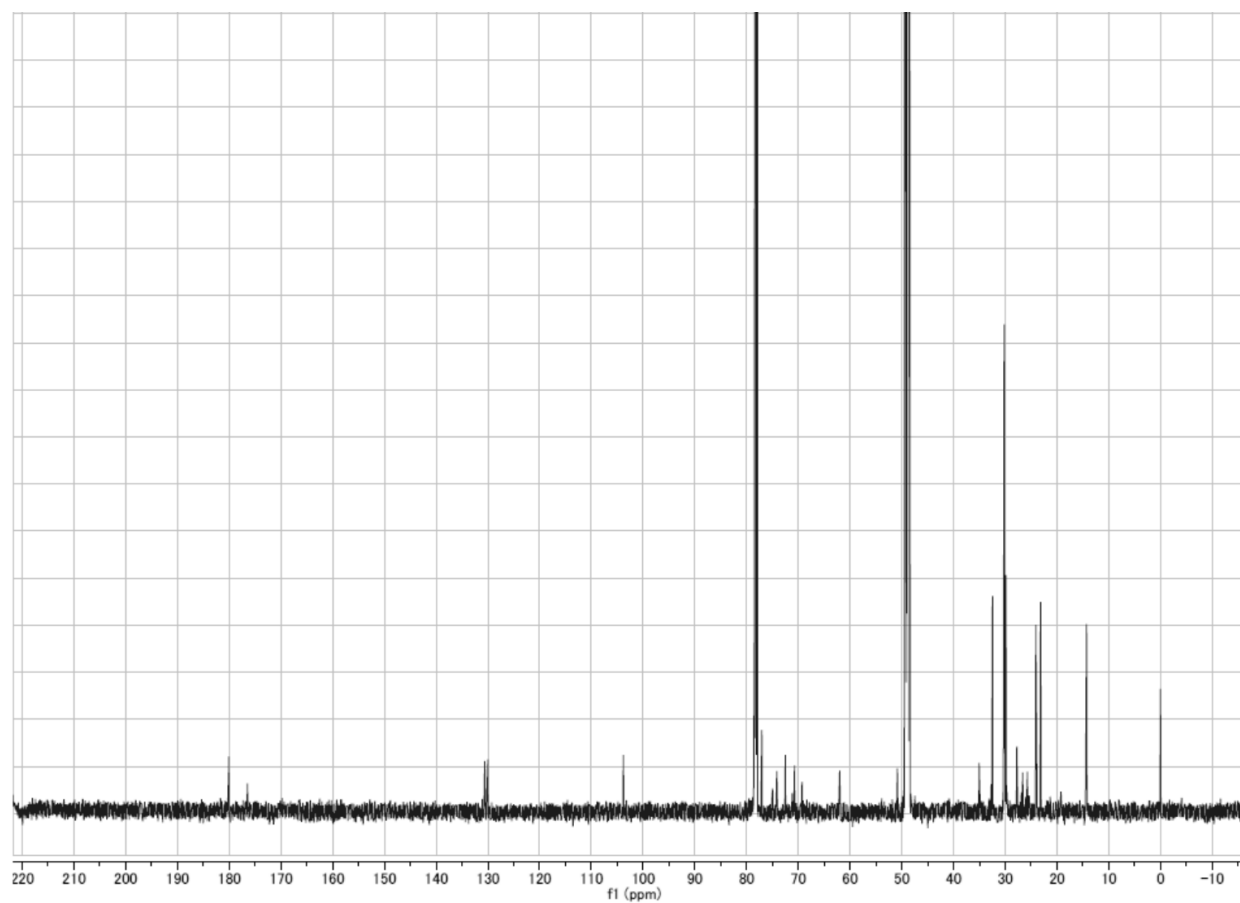


Fig. S 6; ^1H NMR spectrum of compound 4

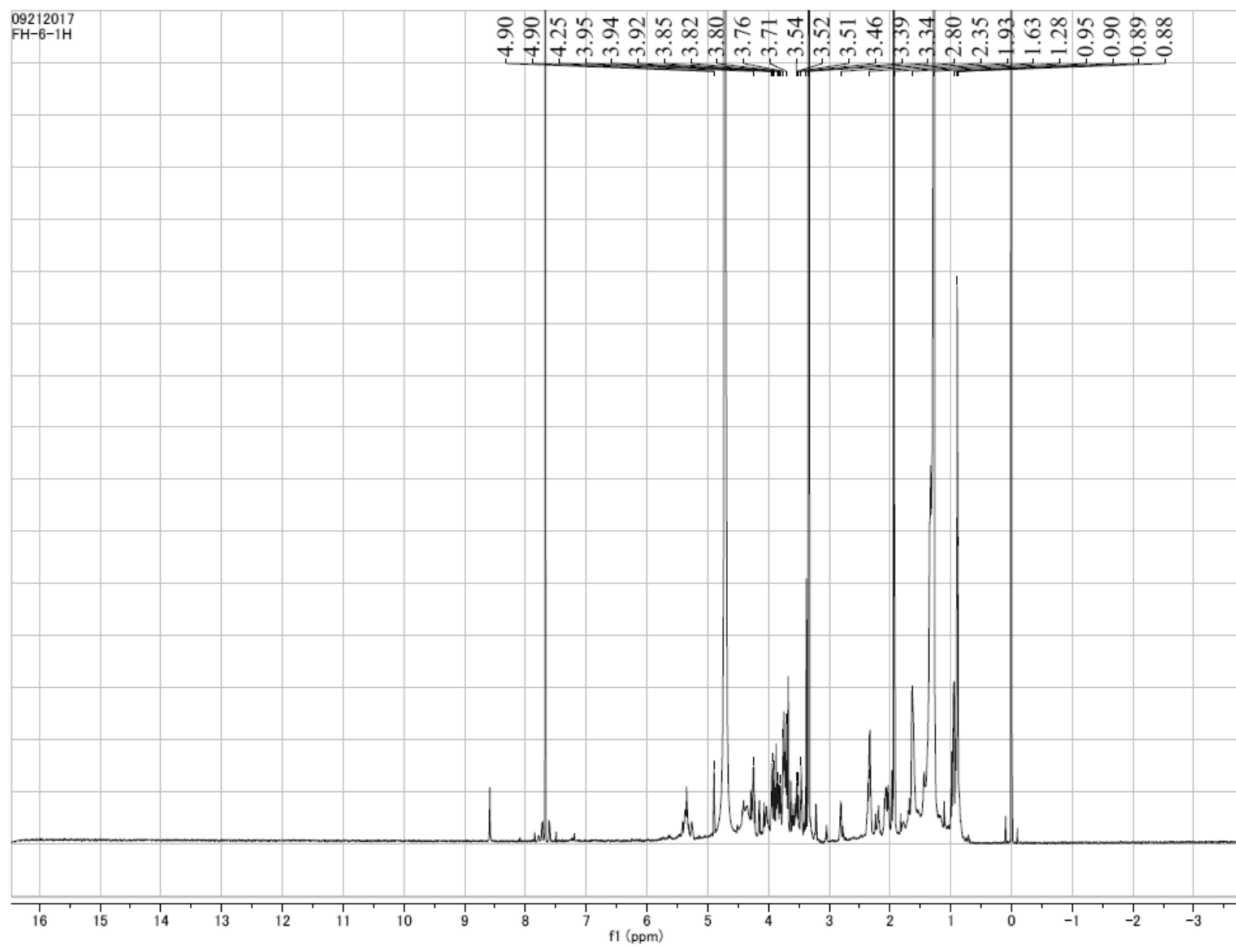


Fig. S 7; ^{13}C NMR spectrum of compound 4

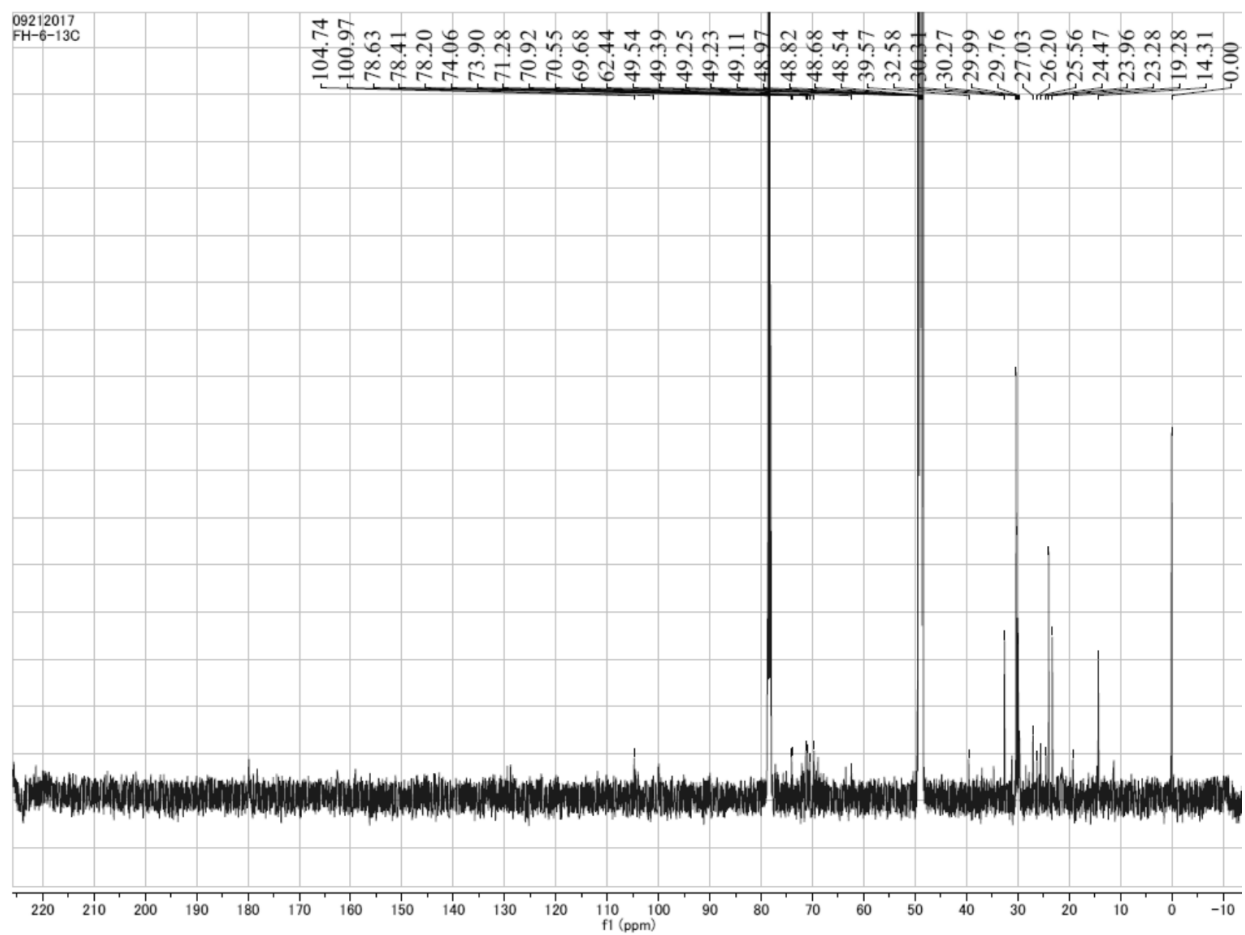


Fig. S 8; HSQC spectrum of compound 4

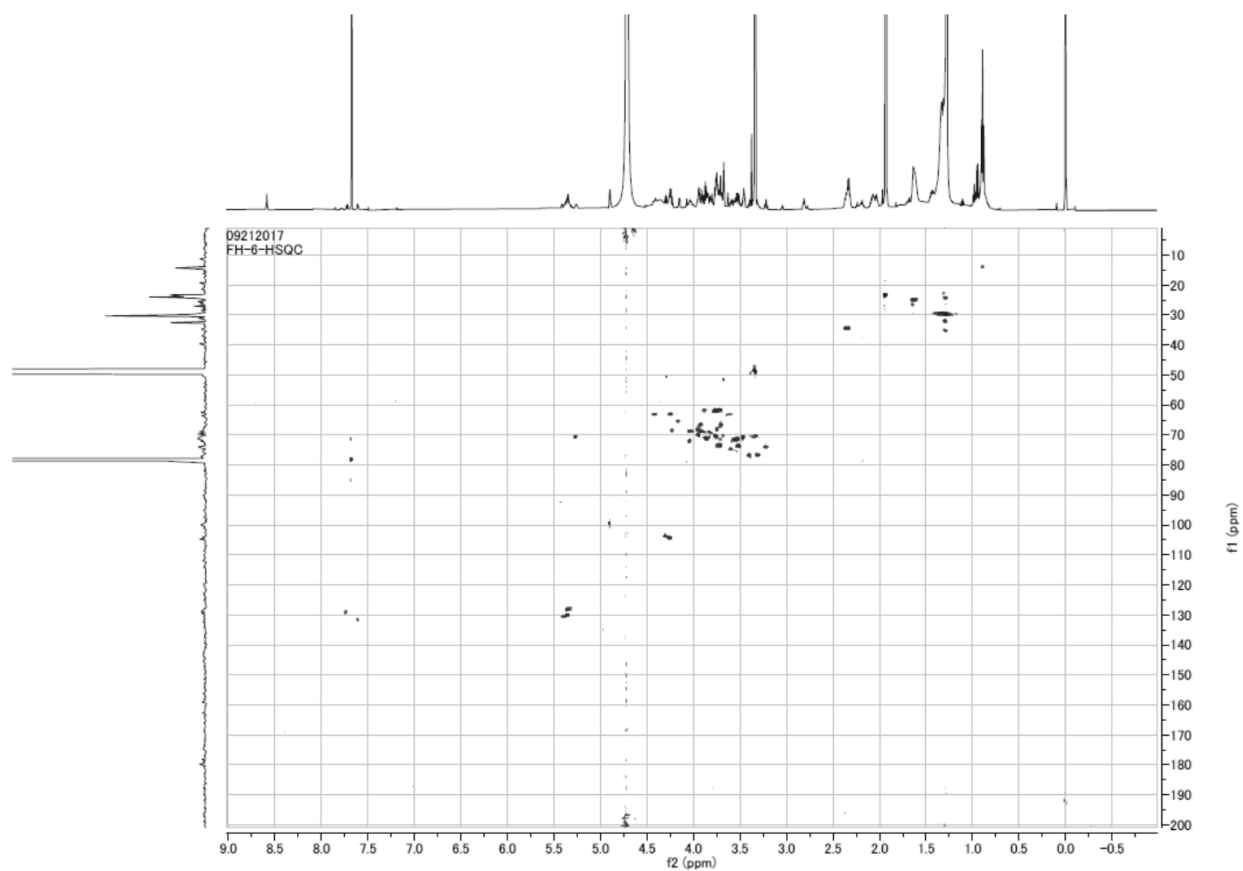


Fig. S 9; HMBC spectrum of compound 4

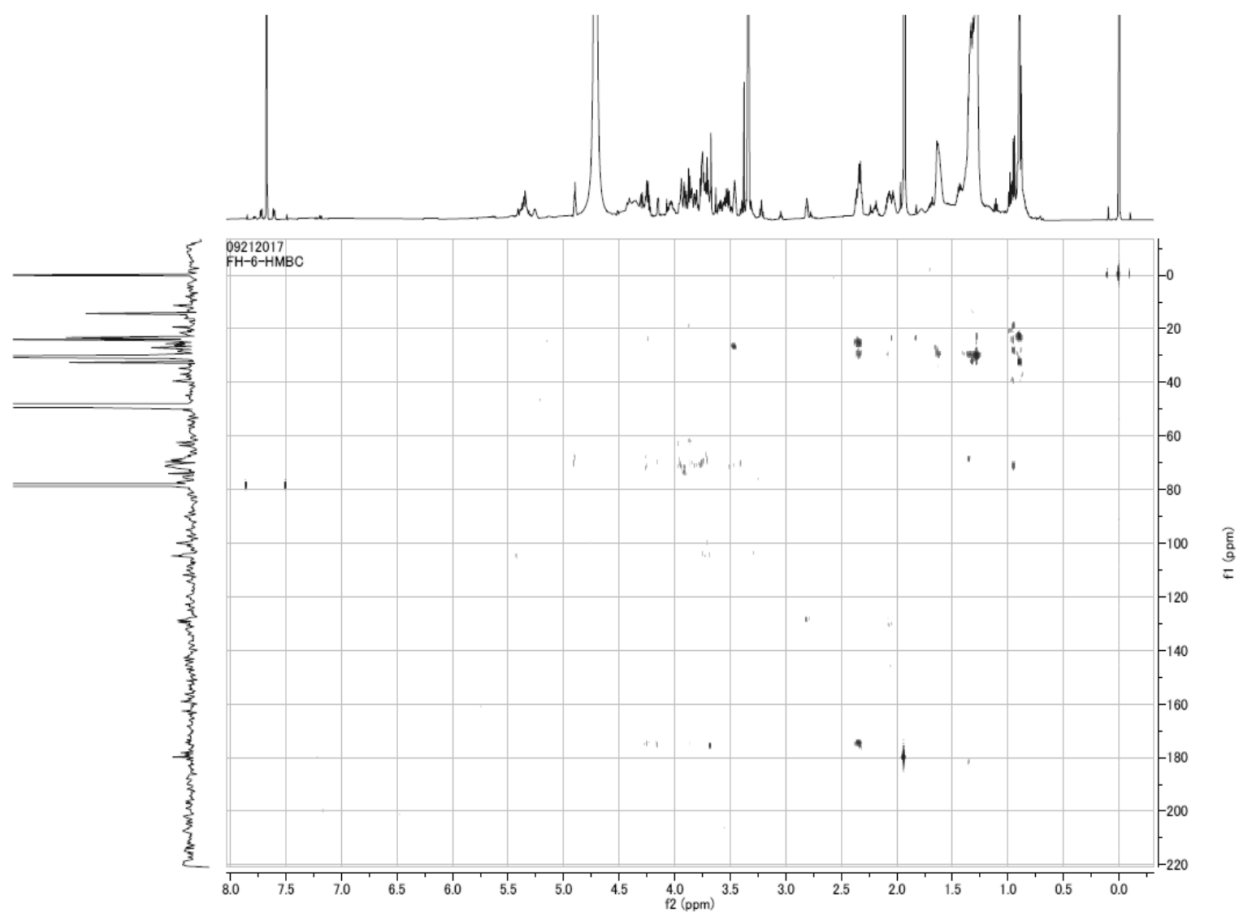


Fig. S 10; HR-Mass spectrum of compound 4

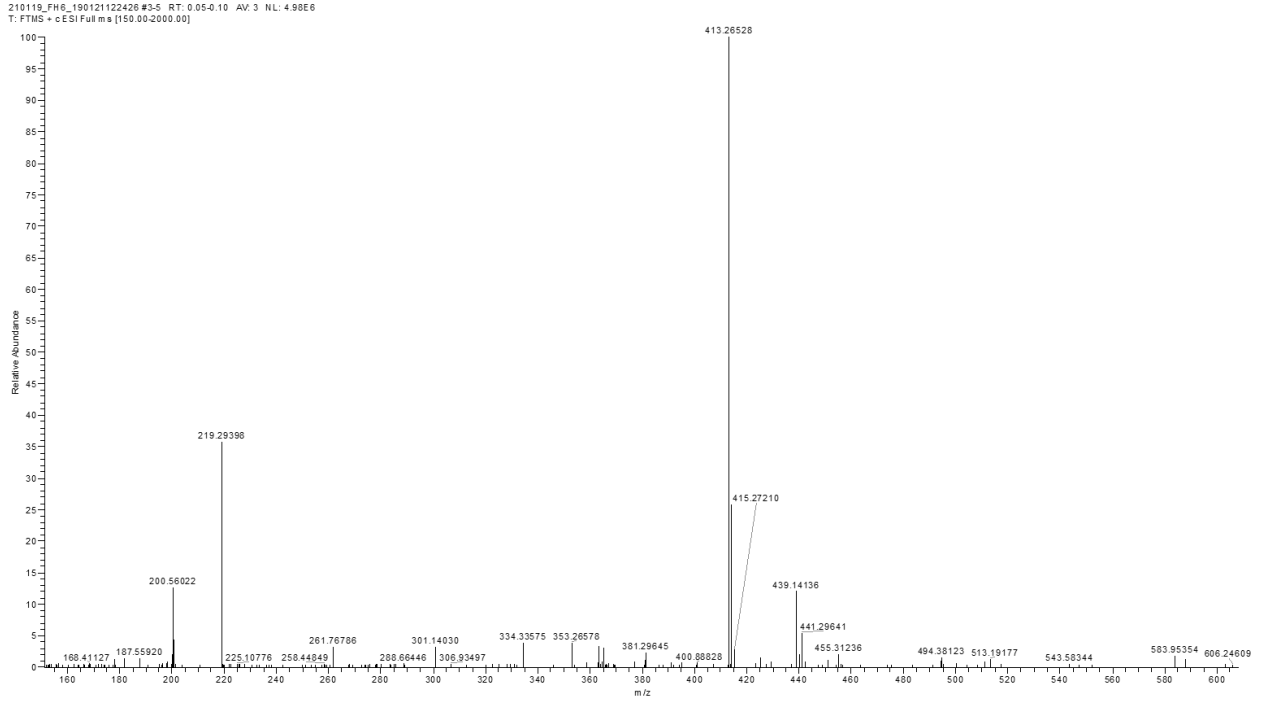
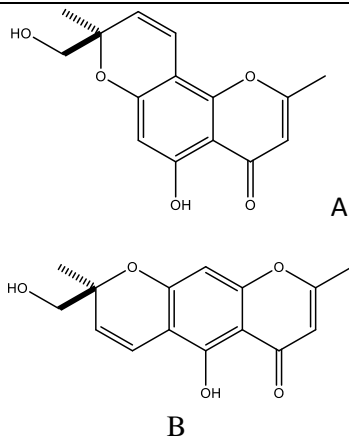
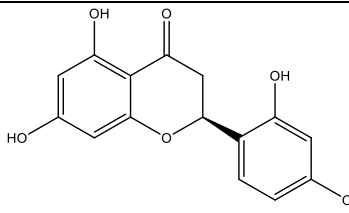
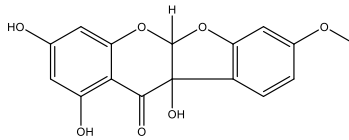
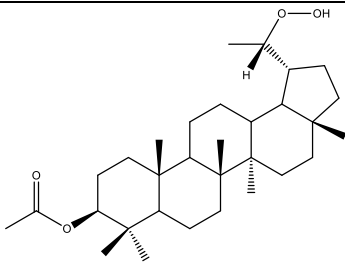
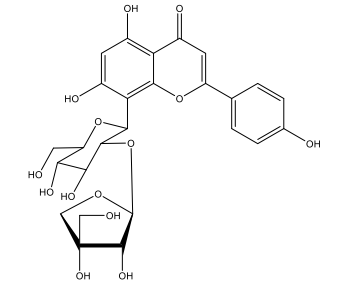
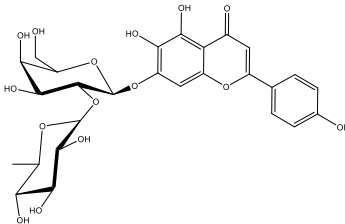
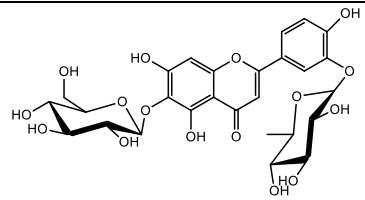
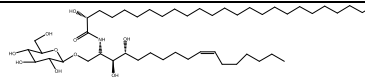
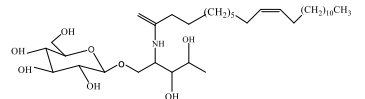
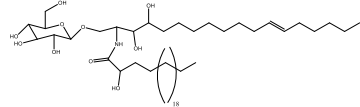
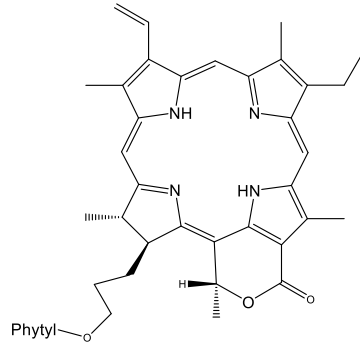
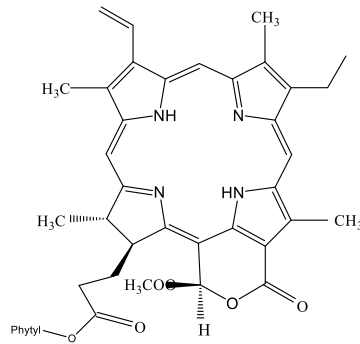


Table S 1; End point metabolites being produced by methanolic extract of *Ficus bengalensis*

Ionization mode	Observed <i>m/z</i>	RT (min)	Predicted Mass ion Formula	Molecular Weight	Name	origin	Ref	structure
Positive	275.0921 8	2.97	C ₁₅ H ₁₄ O ₅	274.08491	Ficuformodiol A; (S)-form Ficuformodiol B (S)-form	<i>F.formosana</i>	(Sheu <i>et al.</i> 2006)	 <p>A</p> <p>B</p>
Negative	287.0552 9	2.92	C ₁₅ H ₁₂ O ₆	288.06257	2',4',5,7-Tetrahydroxyflavanone ; (S)-form (Steppogenin)	<i>F.formosana</i>	(Sheu, <i>et al.</i> 2006)	
Positive	317.0661 6	2.89	C ₁₆ H ₁₂ O ₇	316.05889	5a,10b-Dihydro-1,3,8,10b-tetrahydroxy-11H-benzofuro[2,3-b][1]benzopyran-11-one; 4'-Me ether	<i>F.benjamina</i>	(Dai <i>et al.</i> 2012)	

Negative	487.3784 9	6.87	C ₃₁ H ₅₂ O ₄	488.38577	30-Nor-3,20-lupanediol; (3β,20S)-form, 20-Hydroperoxide, 3-Ac	<i>F. microcarpa</i>	(Chiang and Kuo 2001)	
Negative	563.1396 4	2.43	C ₂₆ H ₂₈ O ₁₄	564.14692	8-C-β-D-Glucopyranosyl-4',5,7-trihydroxyflavone; 2''-O-β-D-Apiofuranosyl Ficuflavoside	<i>F. microcarpa</i>	(Van Kiem <i>et al.</i> 2011)	
Positive	595.1646	2.29	C ₂₇ H ₃₀ O ₁₅	594.15732	4',5,6,7-Tetrahydroxyflavone; 6-O-[α-L-Rhamnopyranosyl-(1→2)-β-D-galactopyranoside]	<i>F. infectoria</i>	(Neeru and Yadava 1994)	

Negative	609.1454 7	2.21	C ₂₇ H ₃₀ O ₁₆	610.15275	3',4',5,6,7-Pentahydroxyflavone; 3'-O- α -L-Rhamnopyranoside, 6-O- β -D-glucopyranoside	<i>F. infectoria</i>	(Lansky and Paavilainen 2010)	
Positive	844.6887 3	6.32	C ₄₈ H ₉₃ NO ₁₀	843.68145 6799	2-Amino-10-heptadecene-1,3,4-triol; (2S,3S,4R,10Z)-form, N-(2R-Hydroxypentacosanoyl), 1-O- β -D-glucopyranoside	<i>F. glumosa</i>	(Nana <i>et al.</i> 2012) <i>glumosa</i>	
					2-Amino-1,3,4-nonadecanetriol; (2 ξ ,3 ξ ,4 ξ)-form, N-(2-Hydroxy-10Z-tricosenoyl), 1-O- β -D-glucopyranoside (ficusoside)	<i>F. elastica</i>	(Mbosso <i>et al.</i> 2012)	
					2-Amino-12-octadecene-1,3,4-triol;			

					(2S,3S,4R,12Z)-form, N-(2R- Hydroxytetracosanoyl), 1-O-β-D- glucopyranoside (mucoside)	<i>F. mucuso</i>	(Bankeu <i>et al.</i> 2010)	
Positive	887.5676 4	6.66	C ₅₅ H ₇₄ N ₄ O ₆	886.56037	ficuschlorine B	<i>F. microcarpa</i>	(Lin <i>et al.</i> 2011)	 

Bankeu JJK, *et al.* 2010. Ceramide and cerebroside from the stem bark of *Ficus mucosa* (Moraceae). *Chemical and Pharmaceutical Bulletin*.58:1661-1665.

Chiang Y-M, Kuo Y-H. 2001. New Peroxy Triterpenes from the Aerial Roots of *Ficus microcarpa*. *Journal of natural products*.64:436-439.

Dai J, *et al.* 2012. Isoflavonoids from *Ficus benjamina* and their inhibitory activity on BACE1. *Planta medica*.78:1357-1362.

Lansky EP, Paavilainen HM. 2010. *Figs: the genus Ficus*: CRC Press.

Lin HY, *et al.* 2011. Ficuschlorins A–D, lactone chlorins from the leaves of *Ficus microcarpa*. *Chemistry & biodiversity*.8:1701-1708.

Mbosso EJT, *et al.* 2012. Ceramide, cerebroside and triterpenoid saponin from the bark of aerial roots of *Ficus elastica* (Moraceae). *Phytochemistry*. 2012/11/01/;83:95-103.

Nana F, *et al.* 2012. Ceramides and cytotoxic constituents from *Ficus glumosa* Del.(Moraceae). *Journal of the Brazilian Chemical Society*.23:482-487.

Neeru J, Yadava R. 1994. Flavonoids of the leaves of *Ficus infectoria*. *Fitoterapia*.65.

Sheu Y-W, *et al.* 2006. Cytotoxic Flavonoids and New Chromenes from *Ficus formosana* f. *formosana*. *Planta medica*. 01/01;71:1165-1167.

Van Kiem P, *et al.* 2011. Antioxidant activity of a new C-glycosylflavone from the leaves of *Ficus microcarpa*. *Bioorganic & medicinal chemistry letters*.21:633-637.