



**Phytochemical and Antimicrobial
Compounds from *Barbeya
oleoides* Schweinf and *Solanum
schimperianum* Hochst**

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Solanum schimperianum Hochst



Barbeya oleoides



Solanum schimperianum

OUTLINES

Introduction

Specific research objective

Preliminary phytochemical screening

Phytochemical study

Biological study

Conclusion

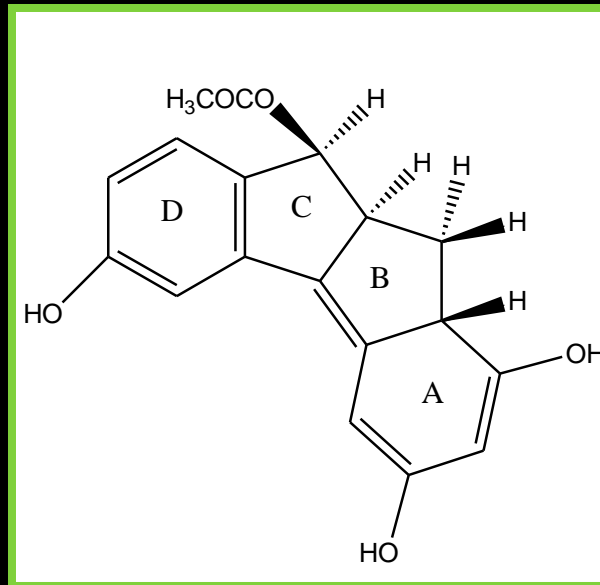
Introduction

1-*Barbeya oleoides*

- ▶ Family Barbeyaceae
- ▶ One plant species
- ▶ Bushy shrub or small tree up to 5 m high
- ▶ Northeast Africa, Arabian peninsula



Barbyol



•B. Ahmed *et al*, *Zeitschrift für Naturforschung*, **57c** (2002).

2- *Solanum schimperianum*

- ▶ Family Solanaceae
- ▶ 90 genera and some 2600 species.
- ▶ Annual, perennial trees or shrubs
- ▶ The nightshade or potato family

•W. C. Evans. *Trease and Evans Pharmacognosy*. 15th edition, (2002).

★ Source of common cultivated crops



Solanum tuberosum



Solanum melongena

★ Source of a medicine or narcotic



Atropa belladonna



Datura stramonium

Ornamentals



Browallia White



Cestrum parqui



Salpiglossis sinuata

Active Constituents

- ▶ Alkaloids
- ▶ Steroidal saponins
- ▶ Withanolides
- ▶ Flavones
- ▶ Carotenoids
- ▶ Anthraquinones
- ▶ Pungent principle
- ▶ Coumarins

Genus Solanum

1700 species



Folk Use of Different *Solanum* species

Brazil

S. paniculatum



Gastric and liver disorders

Germany

S. tuberosum



Antispasmodic and antacid

Kenya

S. incanum



In injuries and against snake bite

India

S. xanthocarpum



Diabetes mellitus

South Africa

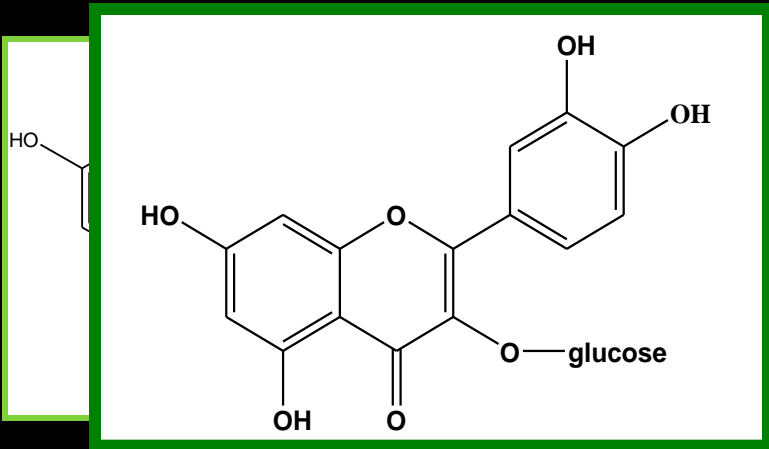
S. aculeastrum



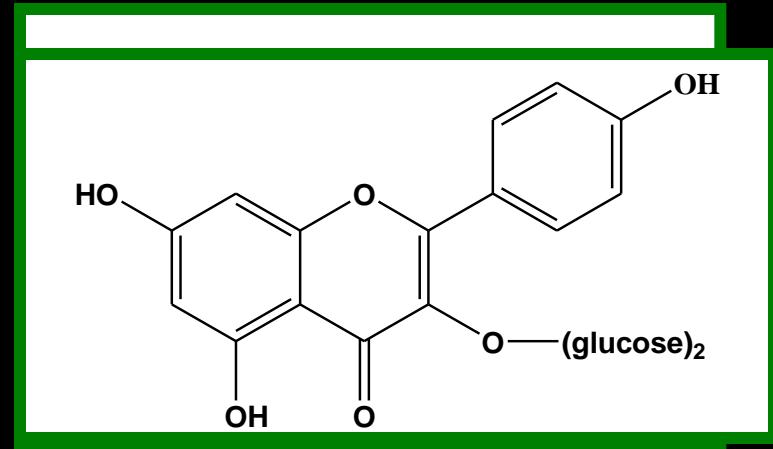
Treatment of cancer and gonorrhoea

Solanum schimperianum Hochst

- ★ Southern region of Saudi Arabia
- ★ Four glycoalkaloids, α and β -solamargine, β and γ -solamarine
- ★ One coumarin
- ★ **Four flavonol**
- ★ *Solanum schimperianum* Hochst has antiplasmodial activity



Isoquercetin
Rutin



3-Kämpferol-3-glucoside

Research objectives

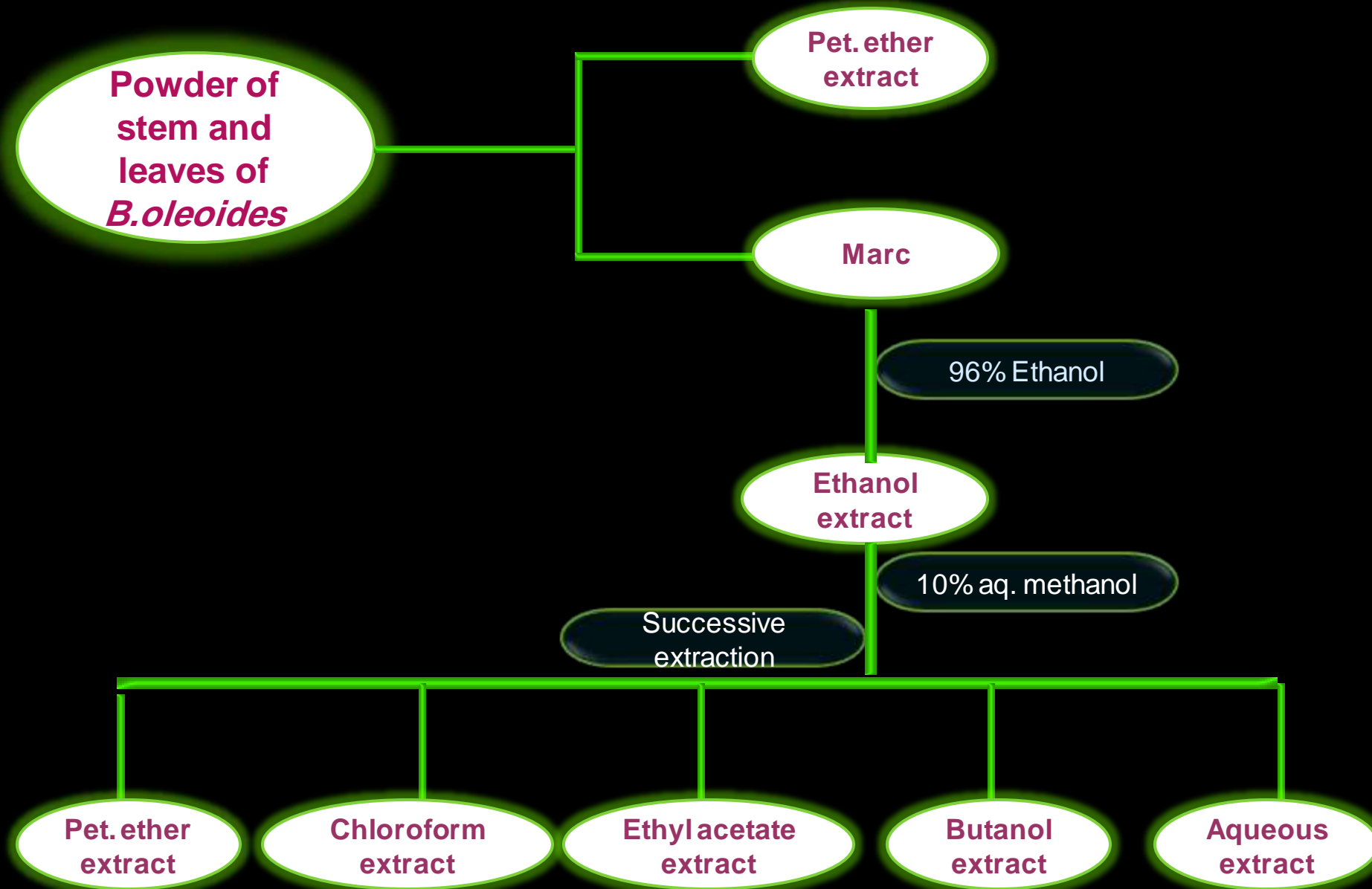
- 1- Preliminary phytochemical screening.
- 2- Investigation of the lipid content of *B. oleoides* .
- 3- Isolation and structure elucidation of different compounds present in *B. oleoides* and *S. schimperianum*.
- 4- Chemical derivatization on small scale of selected compounds.
- 5- The biological activity was concerned on antimicrobial activities of different extracts and isolated compounds of both plants.
- 6- Evaluation of other biological activities of different extracts and or isolated compounds including antioxidant, smooth muscle relaxant and antihypertensive activities.
- 7- Comparison of the obtained results with literature data for the some isolated compound.

**Preliminary Phytochemical
Screening of *Barbeya
oleoides* Schweinf and
Solanum shimperianum
Hochst**

G.E. Trease and W.C. Evans, Pharmacognosy, 15th ed (2002)

1- Whole powdered plant

2- Successive extracts



Results of phytochemical screening of the powder of stem and leaves of *B. oleoides* Schweinf

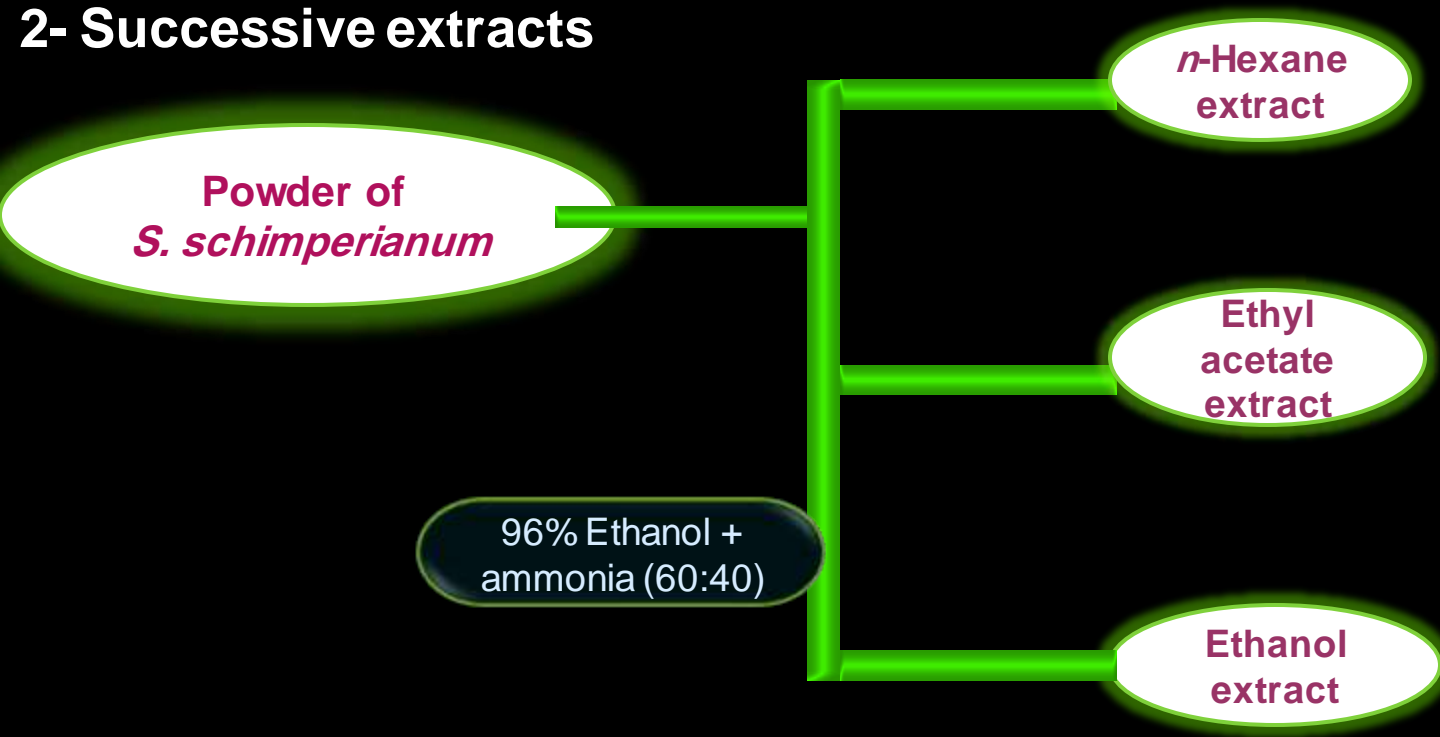
Active constituents	Result
Alkaloids	—
Carbohydrates and/or glycosides	+ ✓
Anthraquinones	—
Flavonoids	+ ✓
Saponins	+ ✓
Triterpenoids and/or sterols	+ ✓
Tannins	+
Volatile constituents	— ✓

- negative; + positive

Solanum schimperianum

1- Whole powdered plant

2- Successive extracts



Results of phytochemical screening of the powder of *S. schimperianum* Hochst

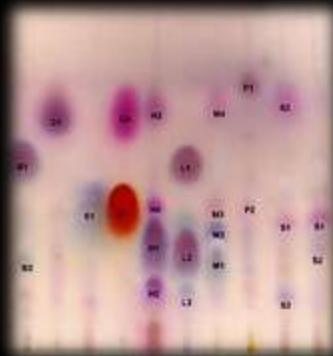
Active constituents	Result
Alkaloids	+ ✓
Carbohydrates and/or glycosides	+ ✓
Anthraquinones	-
Flavonoids	+ ✓
Saponins	+ ✓
Triterpenoids and/or sterols	+ ✓
Tannins	-
Volatile constituents	-

- negative; + positive

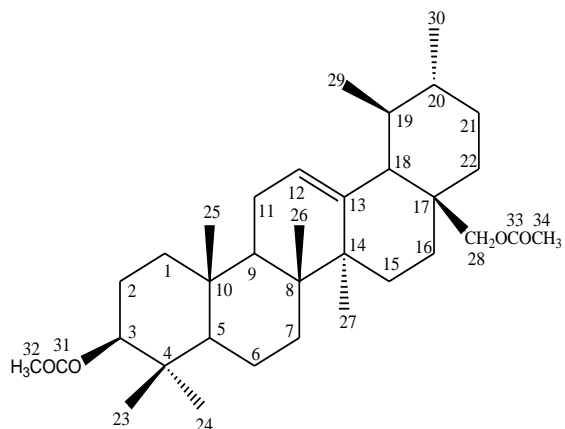
Results of phytochemical screening of the successive extracts of the whole plant of *S. schimperianum* Hochst.

Constituents tested	n-hexane fraction	Ethyl acetate fraction	Ethanol fraction
Alkaloids	—	—	+ ✓
Carbohydrates And/or glycoside	—	+ ✓	+ ✓
Anthraquinones	—	—	—
Cardiac glycosides	—	—	—
Flavonoids: -Aglycone -Glycosides	— —	+ ✓ +	+ ✓ —
Saponins	—	—	+ ✓
Triterpens and/or sterols	+ ✓	+ ✓	+ ✓
Tannins	—	—	—
Volatile constituents	—	—	—

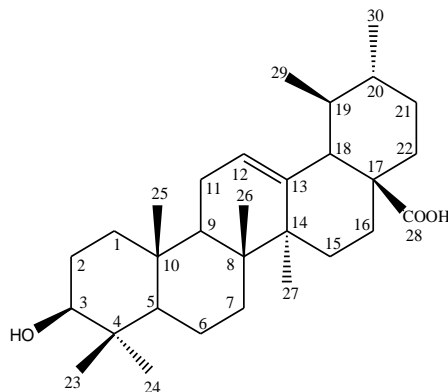
**Phytochemical study of
Barbeya oleoides and
*Solanum shimperianum***



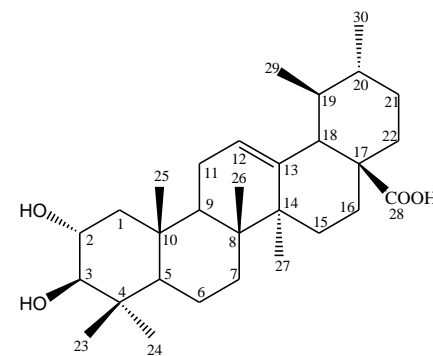
Structures of isolated compounds from *Barbeya oleoides*



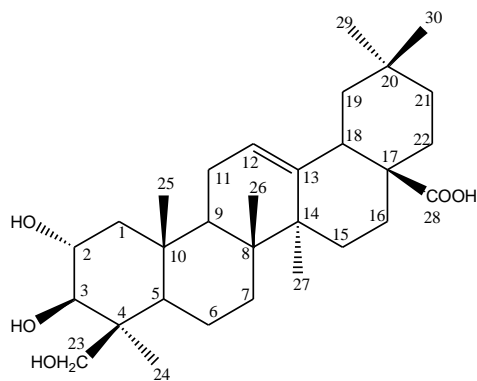
B-1(Uvaol diacetate)



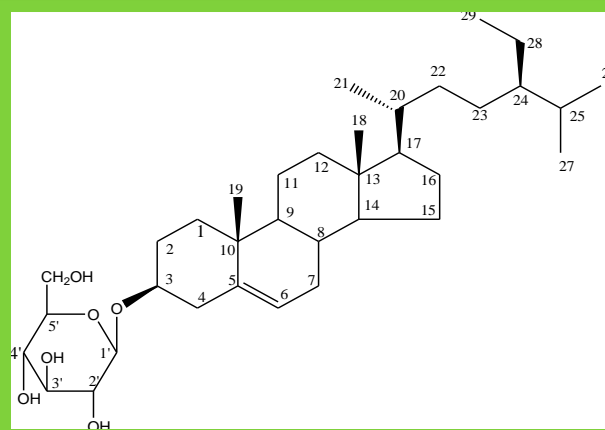
B-2 (Ursolic acid)



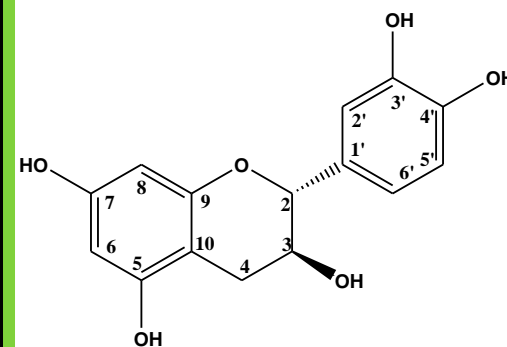
B-3 (Corsolic acid)



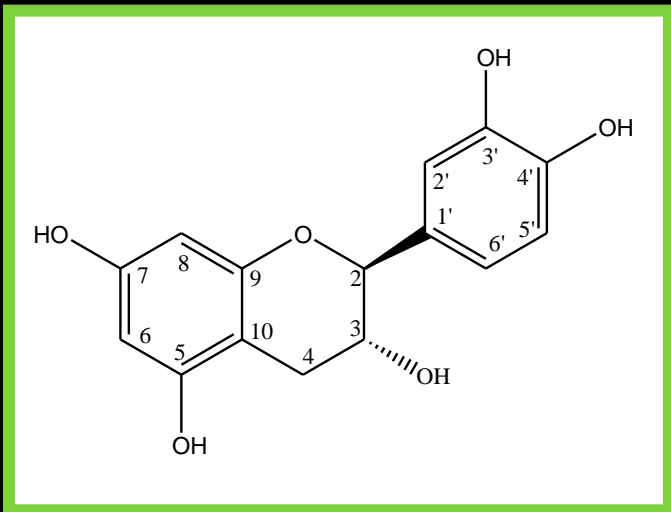
B-4 (Arjunolic acid)



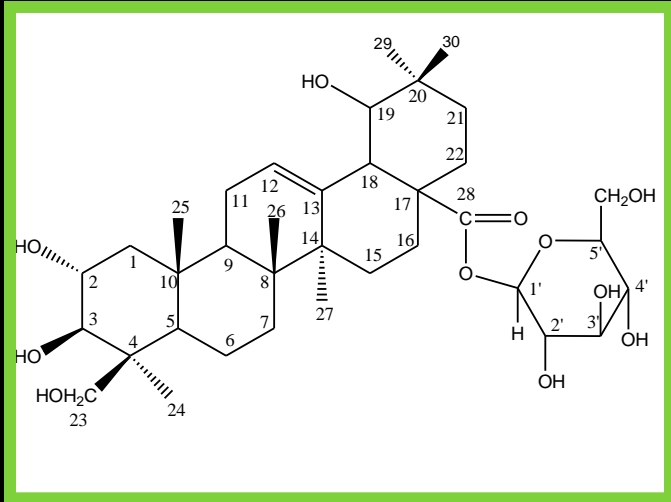
B-5 (β -sitosterol-3-O- β -D-glucoside)



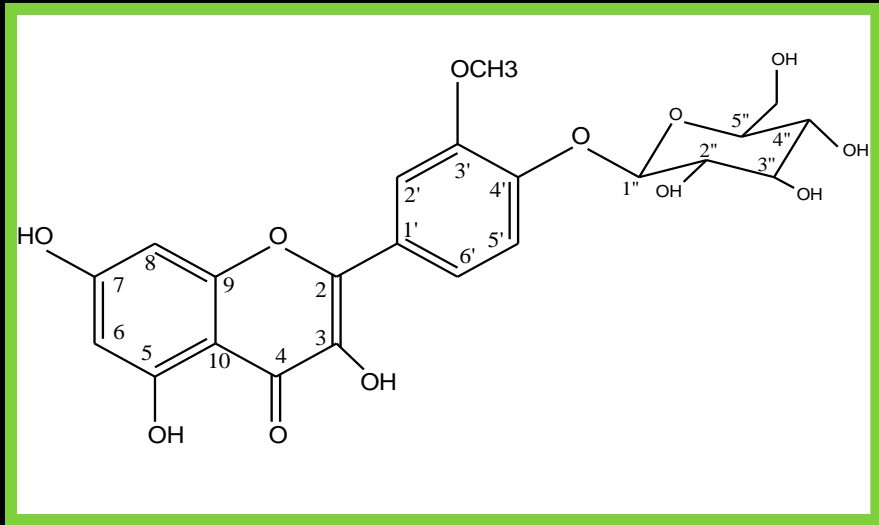
B-6 (Catechin)



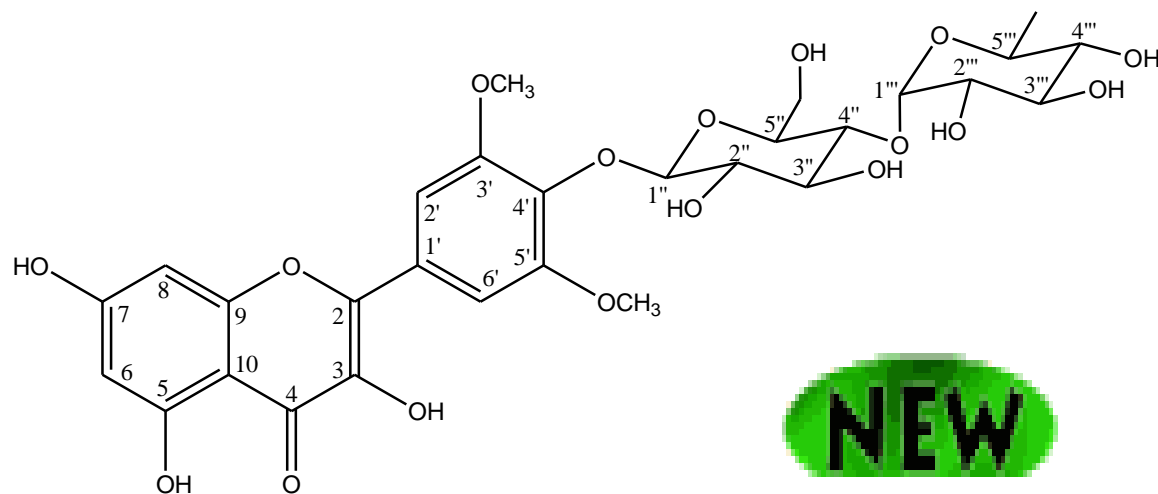
B-7 (Epicatechin)



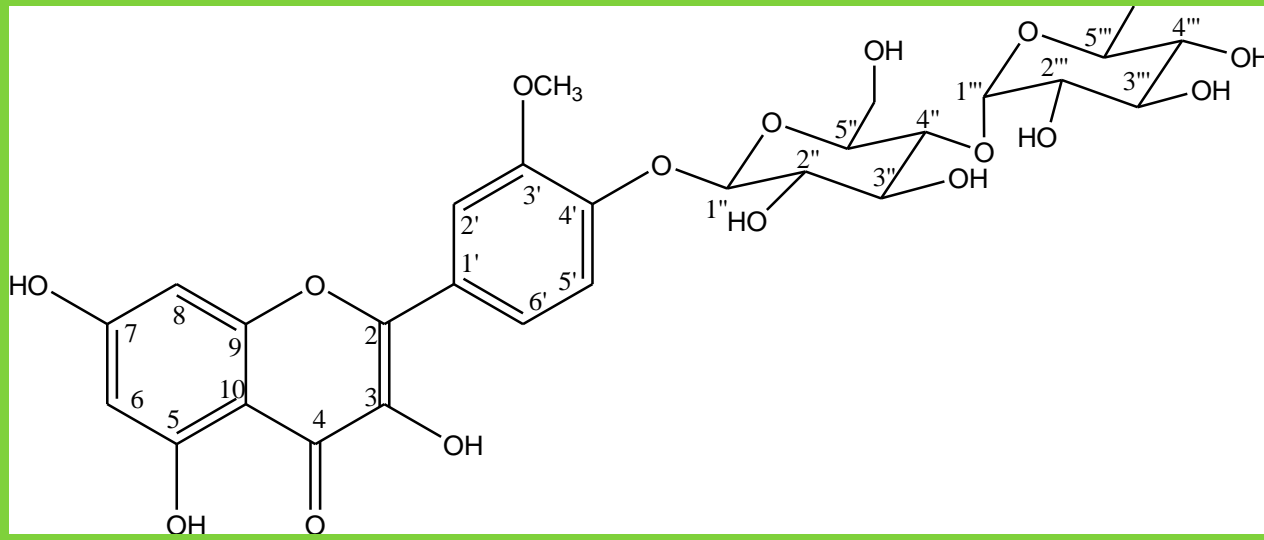
B-8 (Arjunoglucoside I)



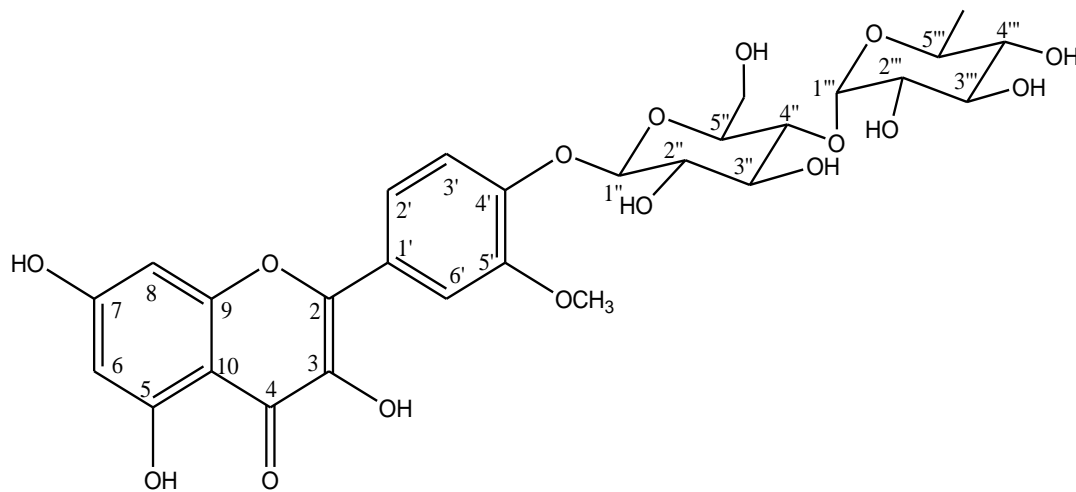
B-9(Isorhamnetin-4'-O-glucoside)



B-10-(4'-O-(1''-4''-O-L-rhamnopyranosyl)-β-D-(glucopyranosyl-3',5' dimethoxymyricetin)

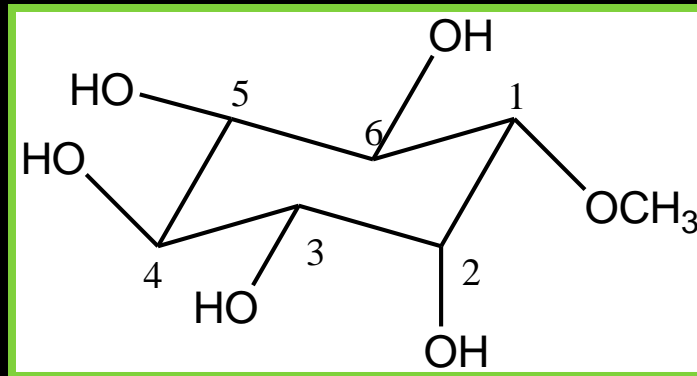


B-11a (4'- O-(1'''-4''-O-L-rhamnopyranosyl)-β-D-(glucopyranosyl-3'-methoxyquercetin)

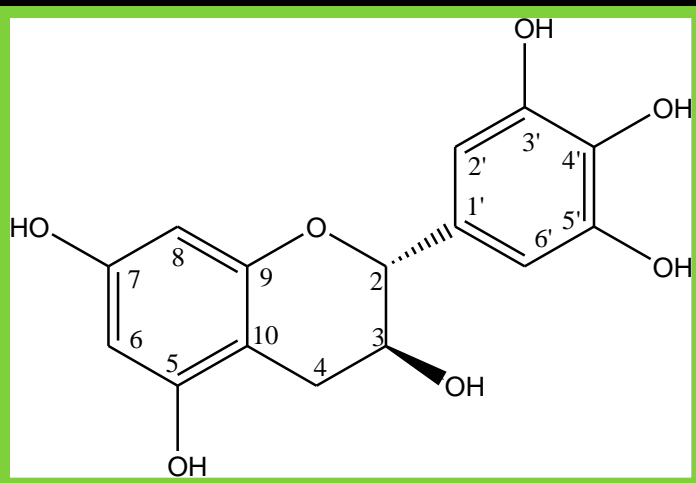


B-11b (4'- O-(1'''-4''-O-L-rhamnopyranosyl)-β-D-(glucopyranosyl-5'-methoxyquercetin)

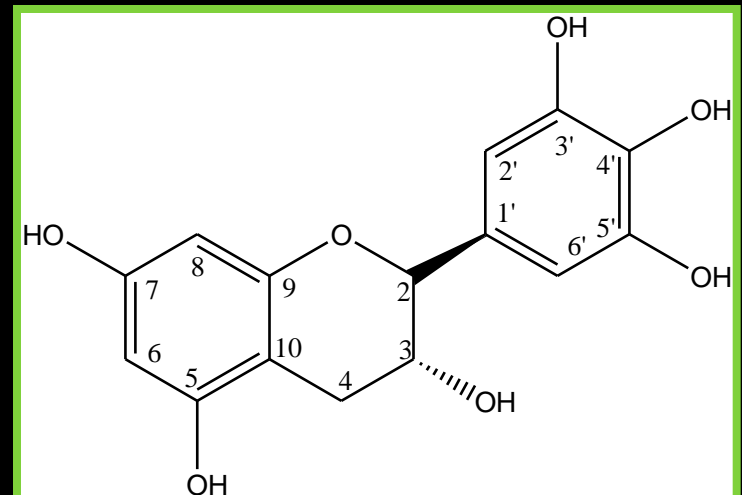
NEW



B-12 (D (-) bornesitol)



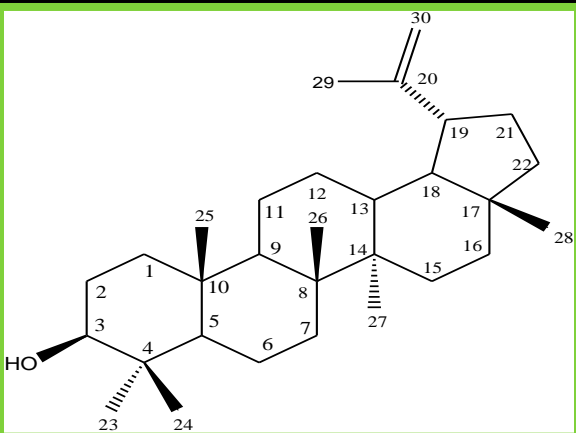
B-13 (Gallocatechin)



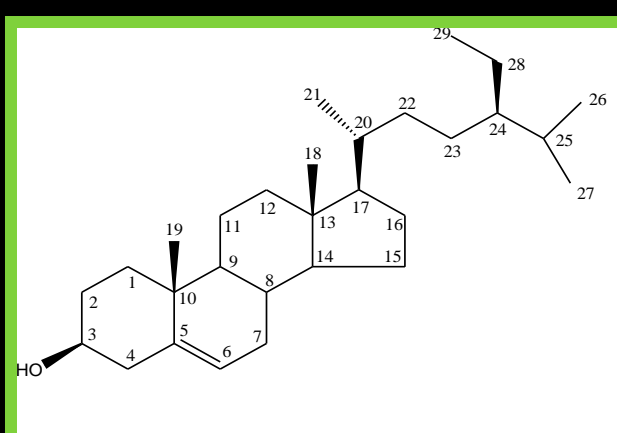
B-14 (Epigallocatechin)

Solanum schimperianum Hochst

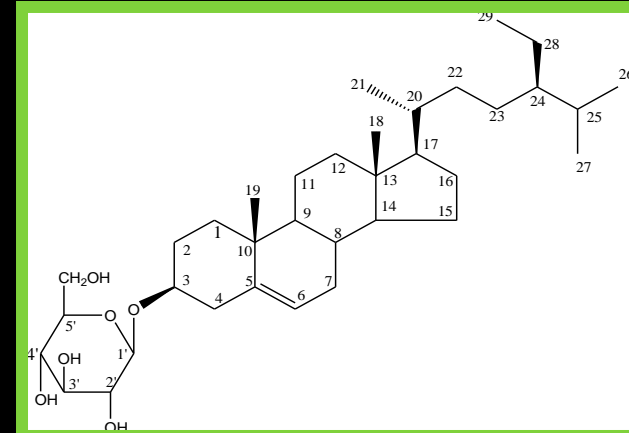
Structures of isolated compounds from *Solanum schimperianum*



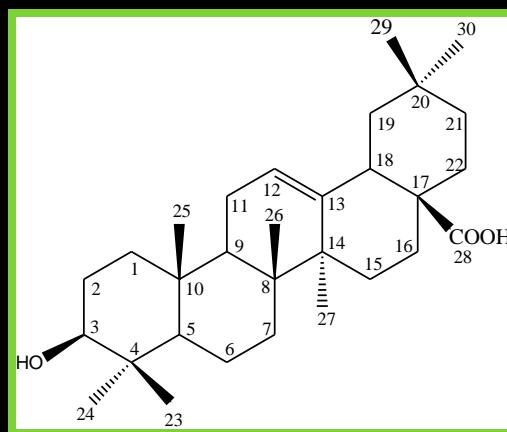
S-1 (Lupeol)



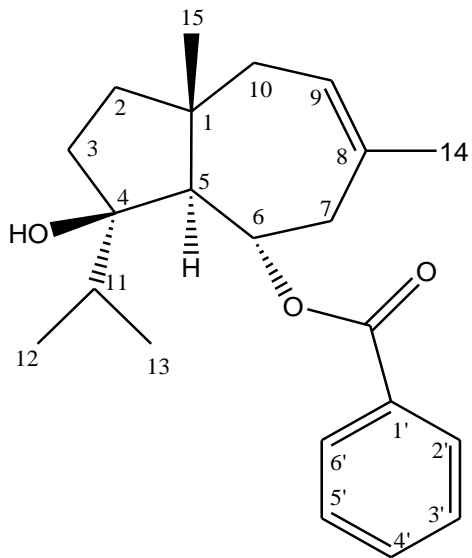
S-2 (β -Sitosterol)



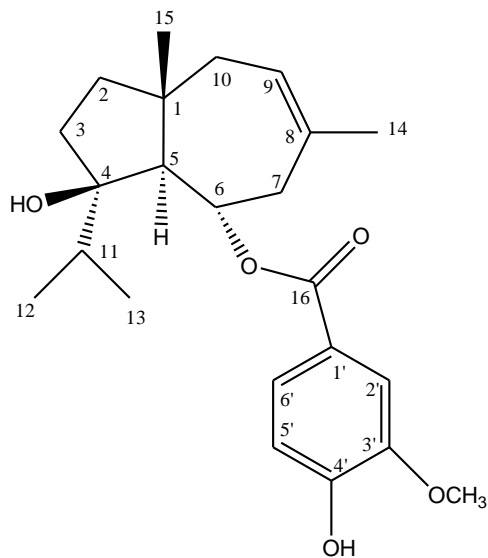
S-3 (β -Sitosterol-3- β -D-glucoside)



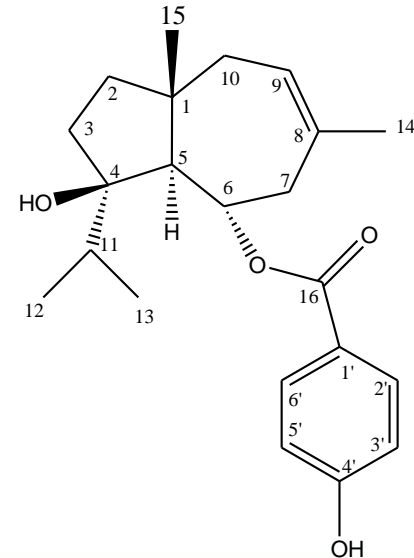
S-4 (Oleanolic acid)



S-5 (Teferidin)



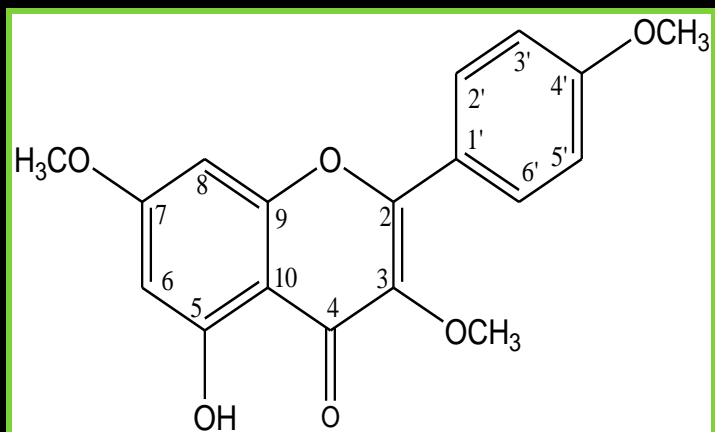
S-6 (Teferin)



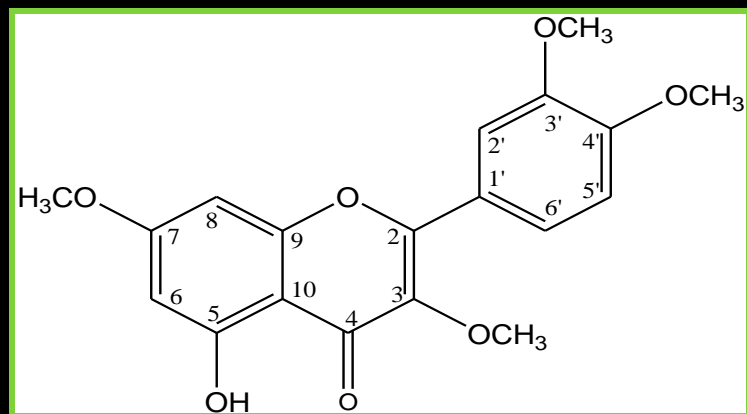
S-7 (Ferutinin)

FIRST TIME

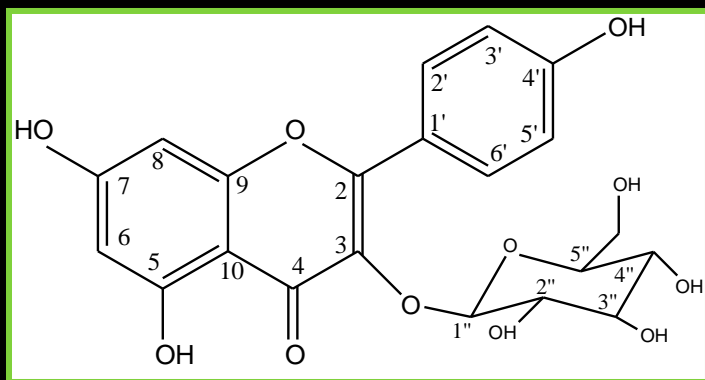
Solanaceae



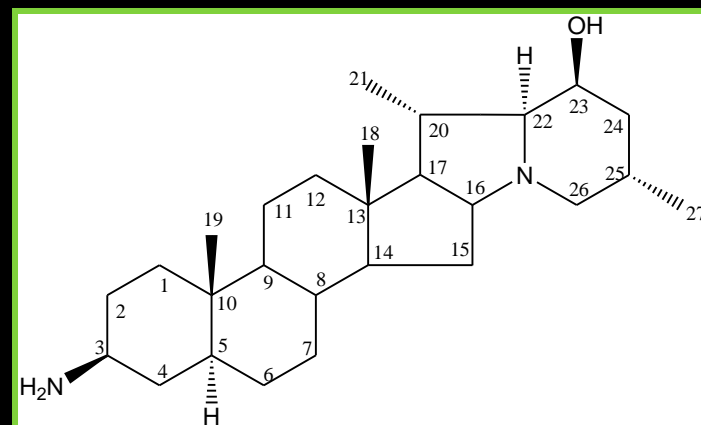
S-8 (5-Hydroxy-3,7,4'- trimethoxyflavone)



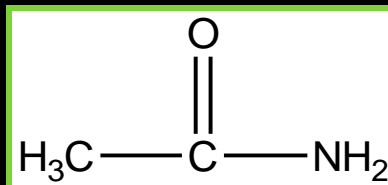
S-9 (Retusin)



S-10 (Kaempferol-3-O-glucopyranoside)

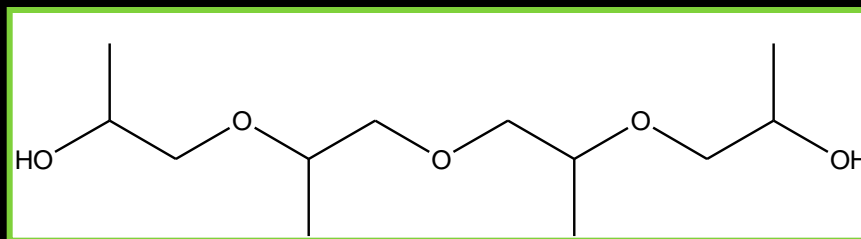


S-11 (Solanopubamine)



S-12 (Acetamide)

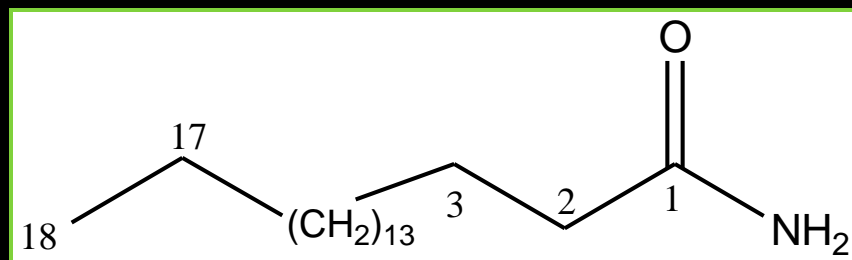
SECOND
TIME



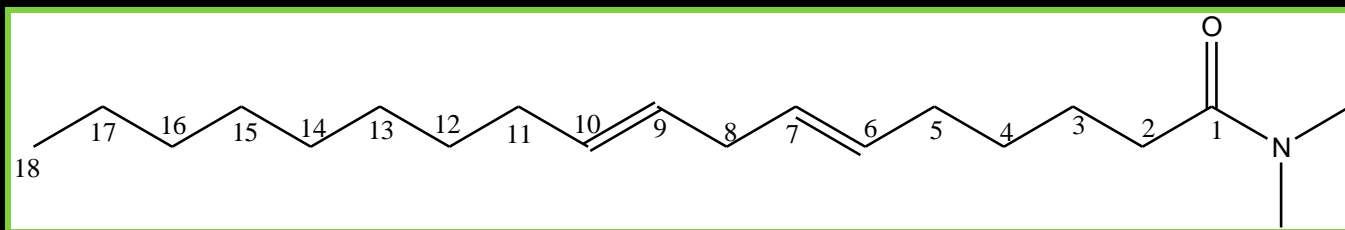
S-13 (1-{1-[2-(2 Hydroxypropoxy) propoxy] propan-2-yloxy} propan-2-ol)

FIRST
TIME

NATURE



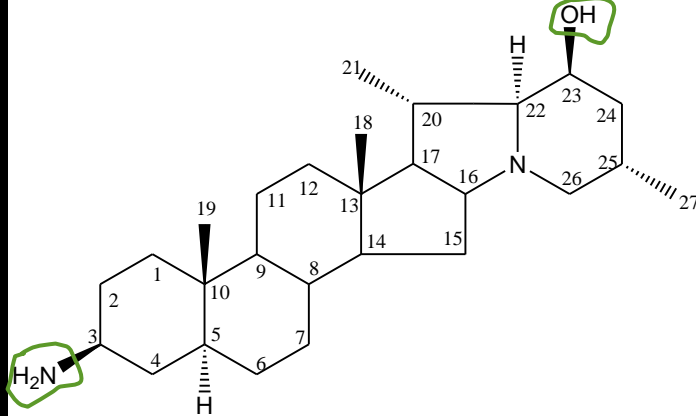
S-14 (Stearamide)



S-15 (6E,9E)-N,N-dimethyloctadeca-6,9-dieneamide

**FIRST
TIME**

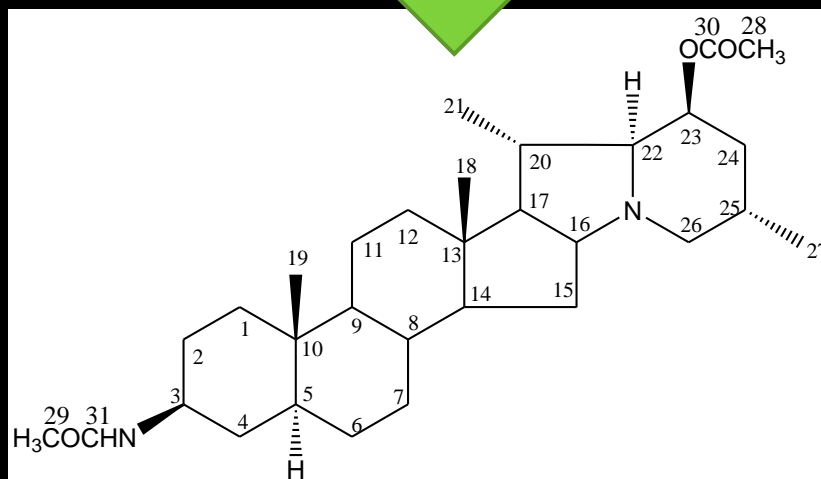
Solanaceae



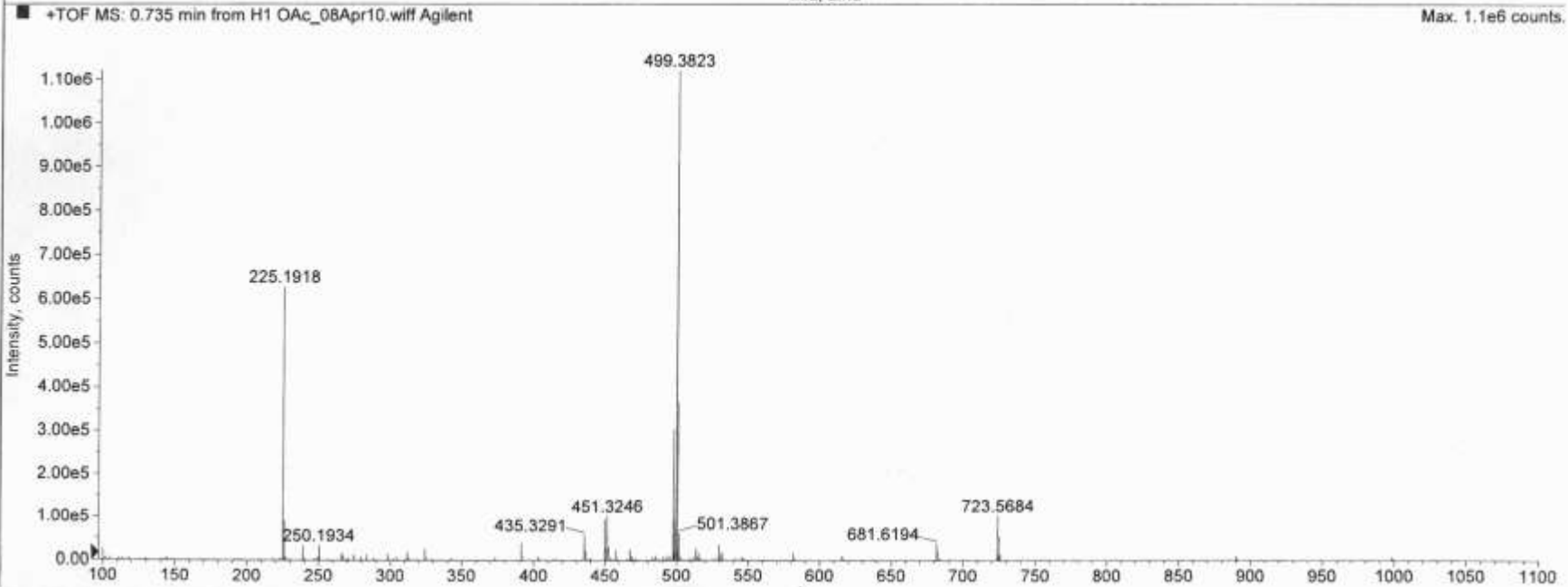
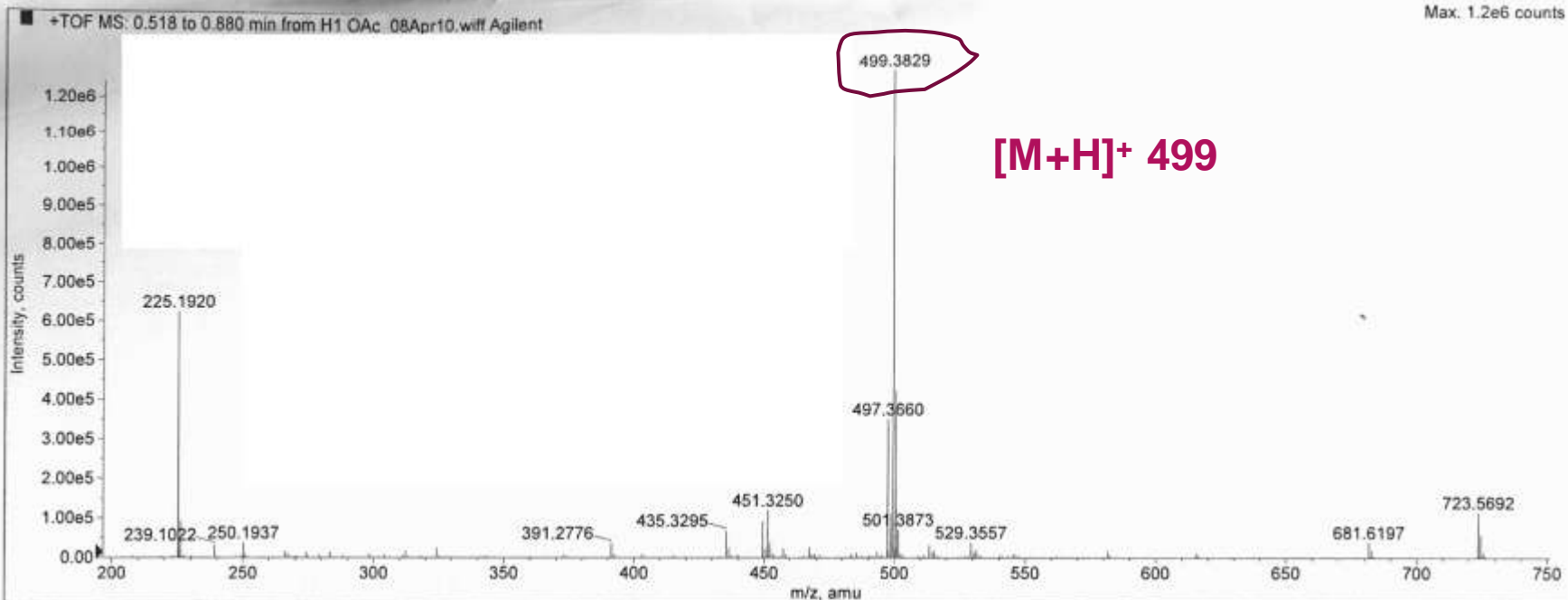
S-11 (Solanopubamine)

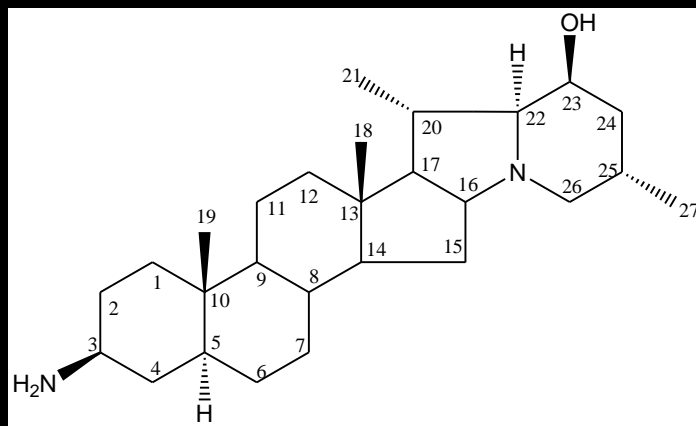
Acetylation

Pyridine
Acetic anhydride



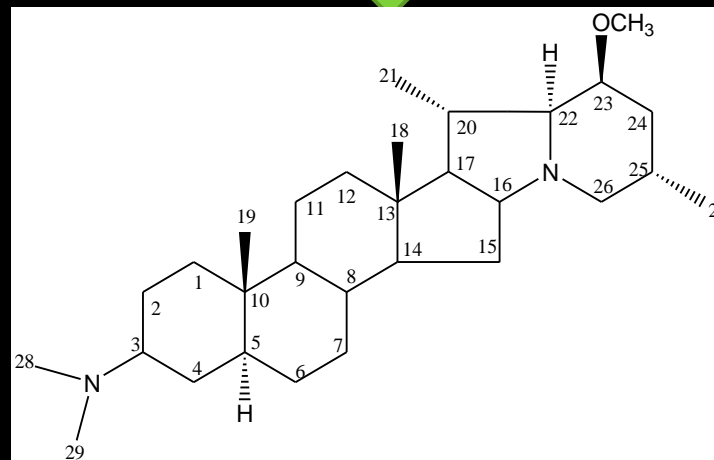
S-11a (3-N, 23-O-diacetyl-solanopubamine)





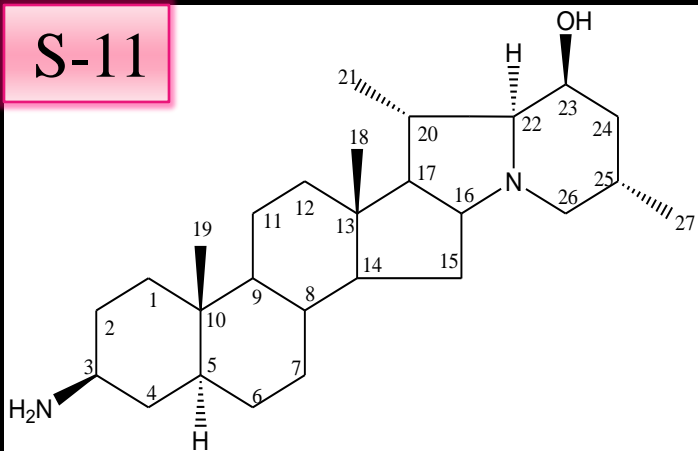
Methylation

CH₃I/MgCO₃

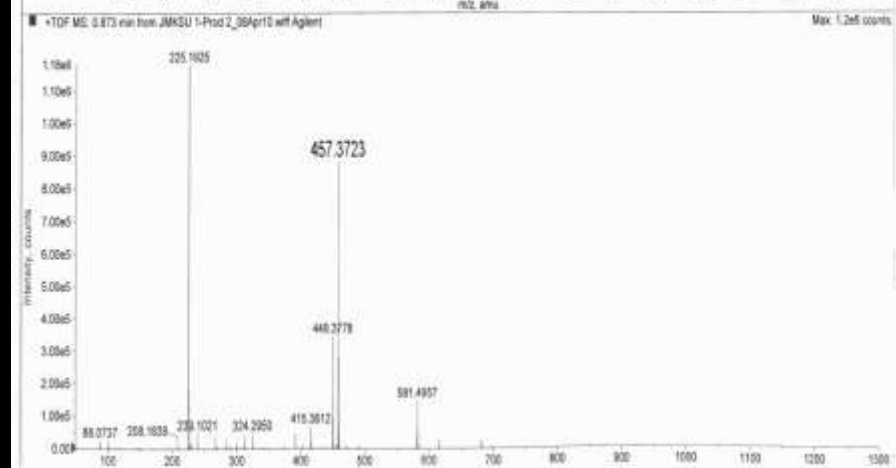
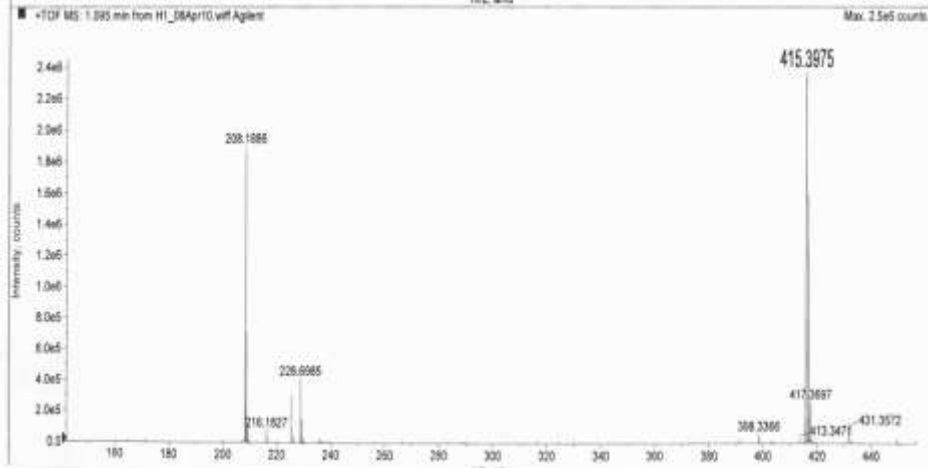
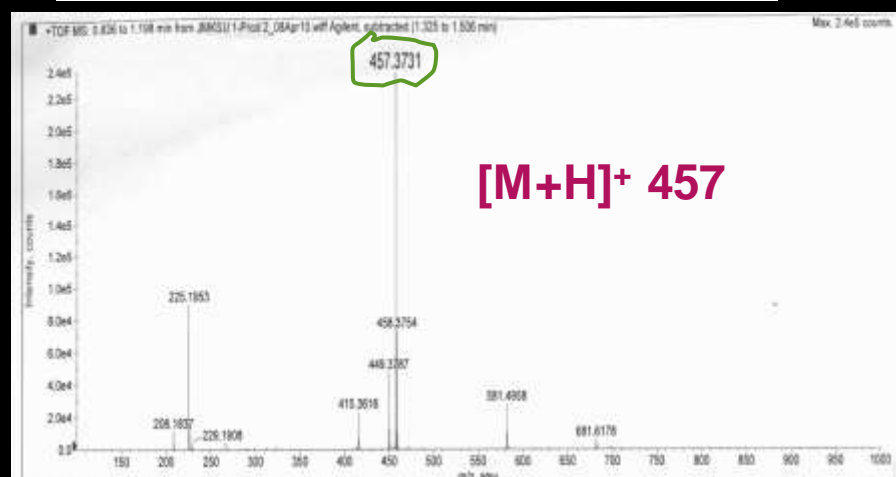
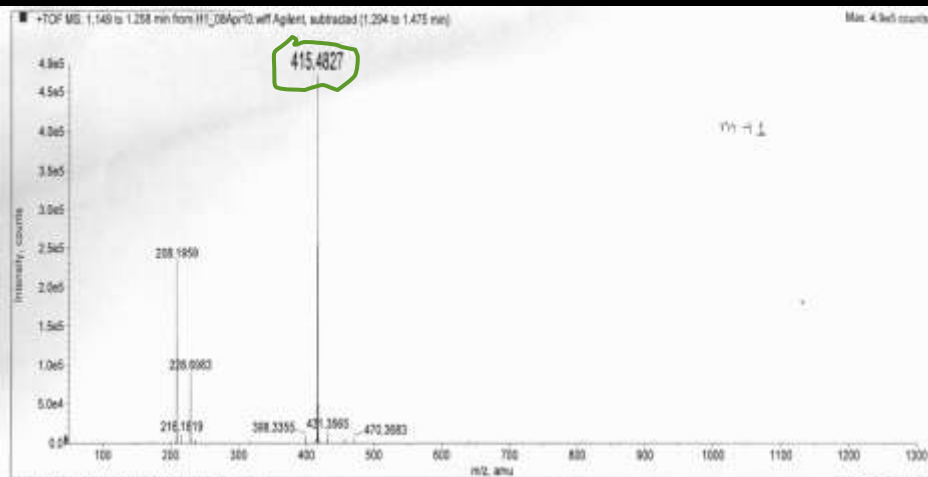
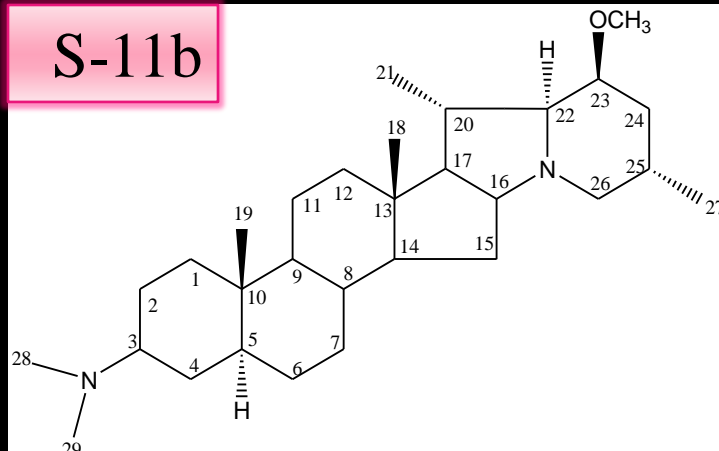


S-11b (3,3-N,N-Dimethyl-23-O-methylsolanopubamine)

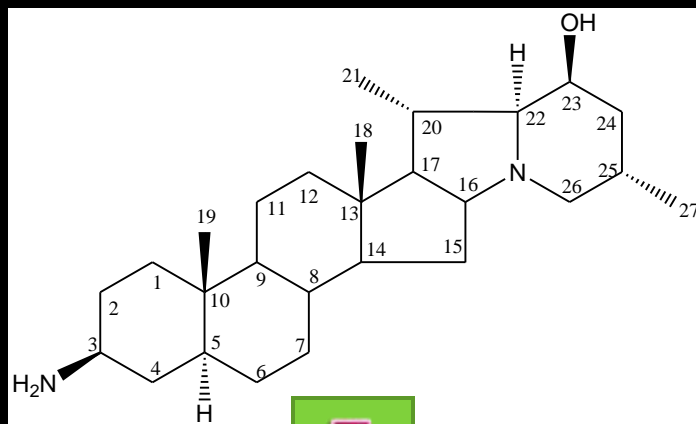
S-11



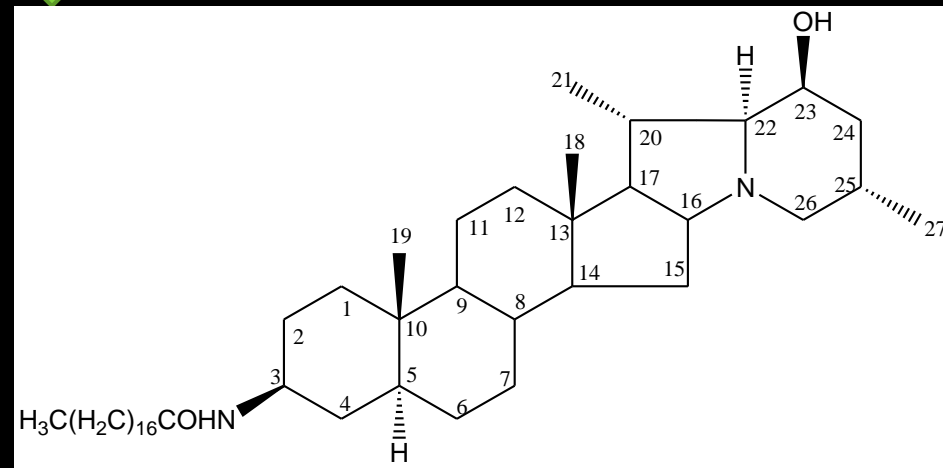
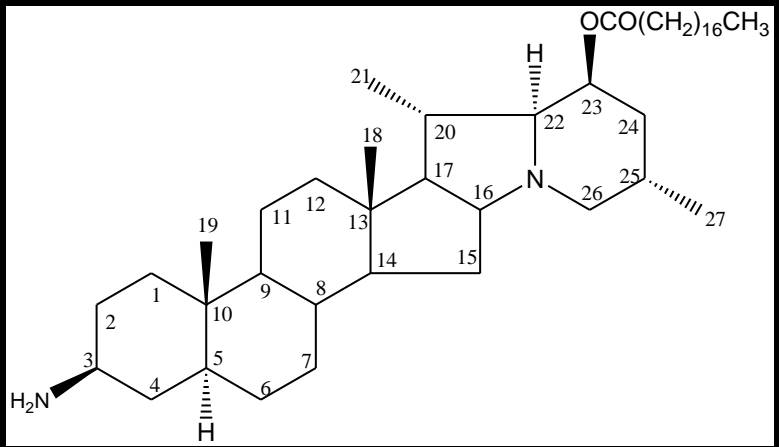
S-11b



**FIRST
TIME**

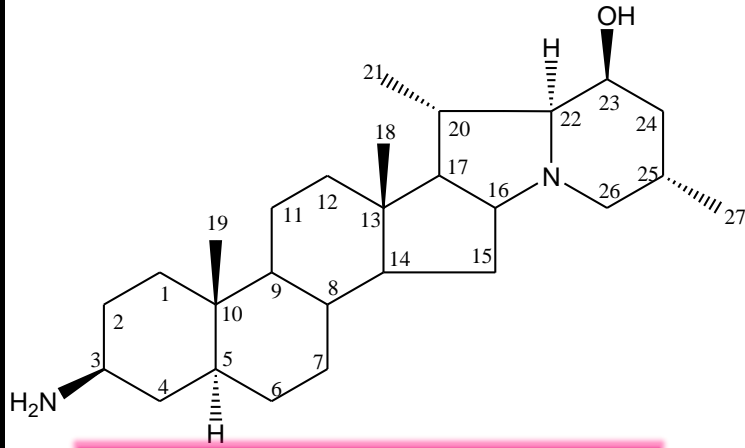


Octadecanoic acid

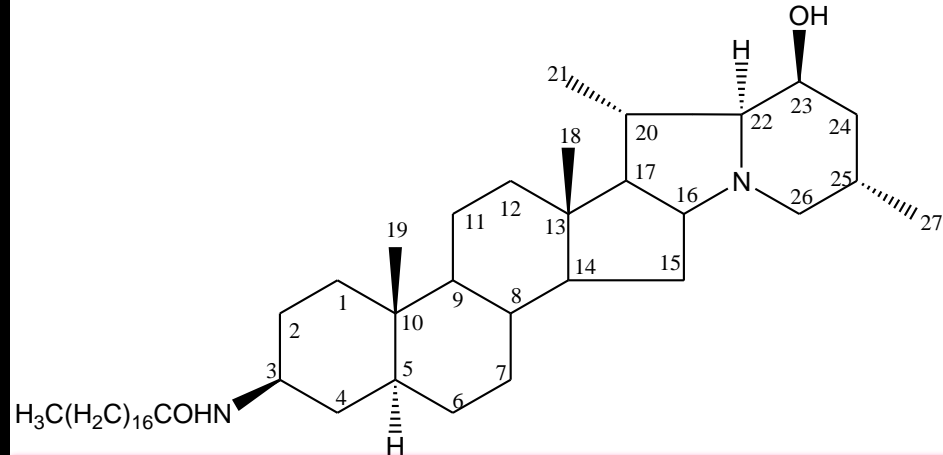


S-11d (23-*O*-octadecanoate-solanopubamine)

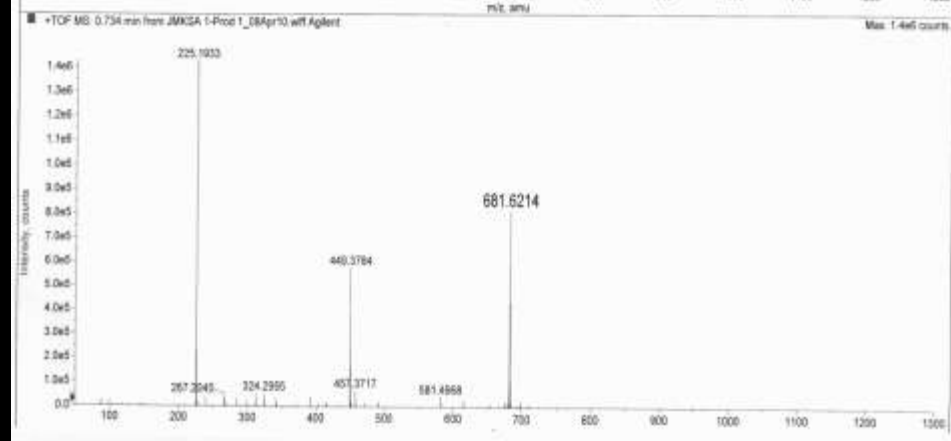
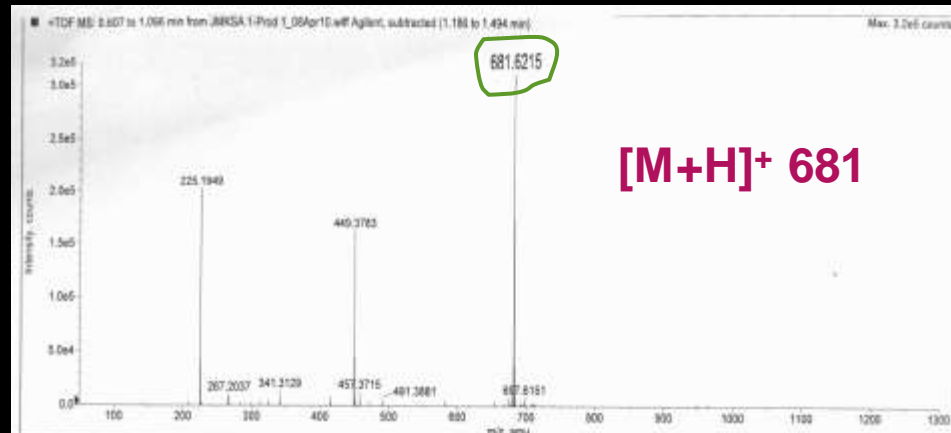
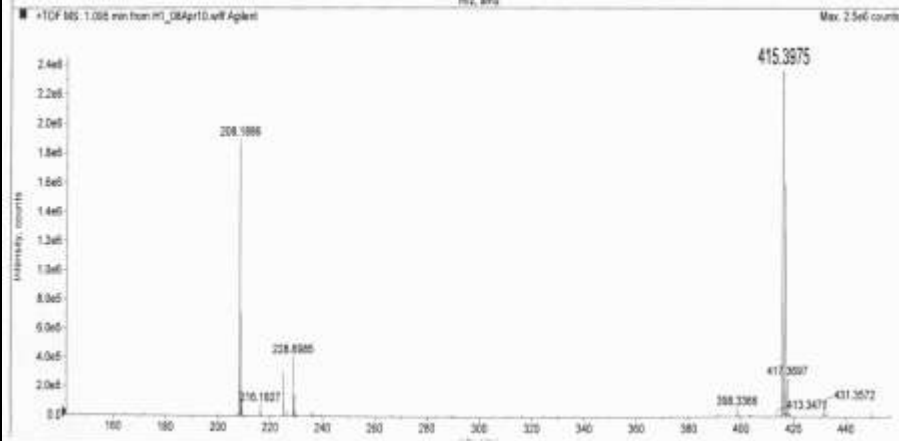
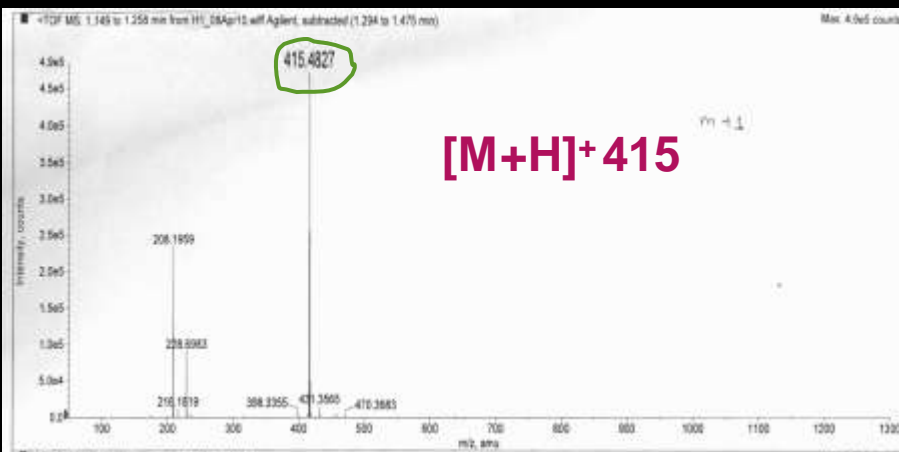
S-11c (3-*N*-octadecanoate-solanopubamine)

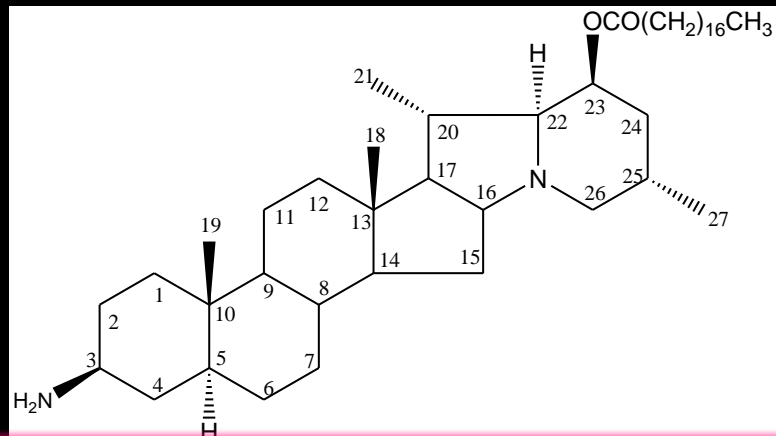


S-11 (Solanopubamine)

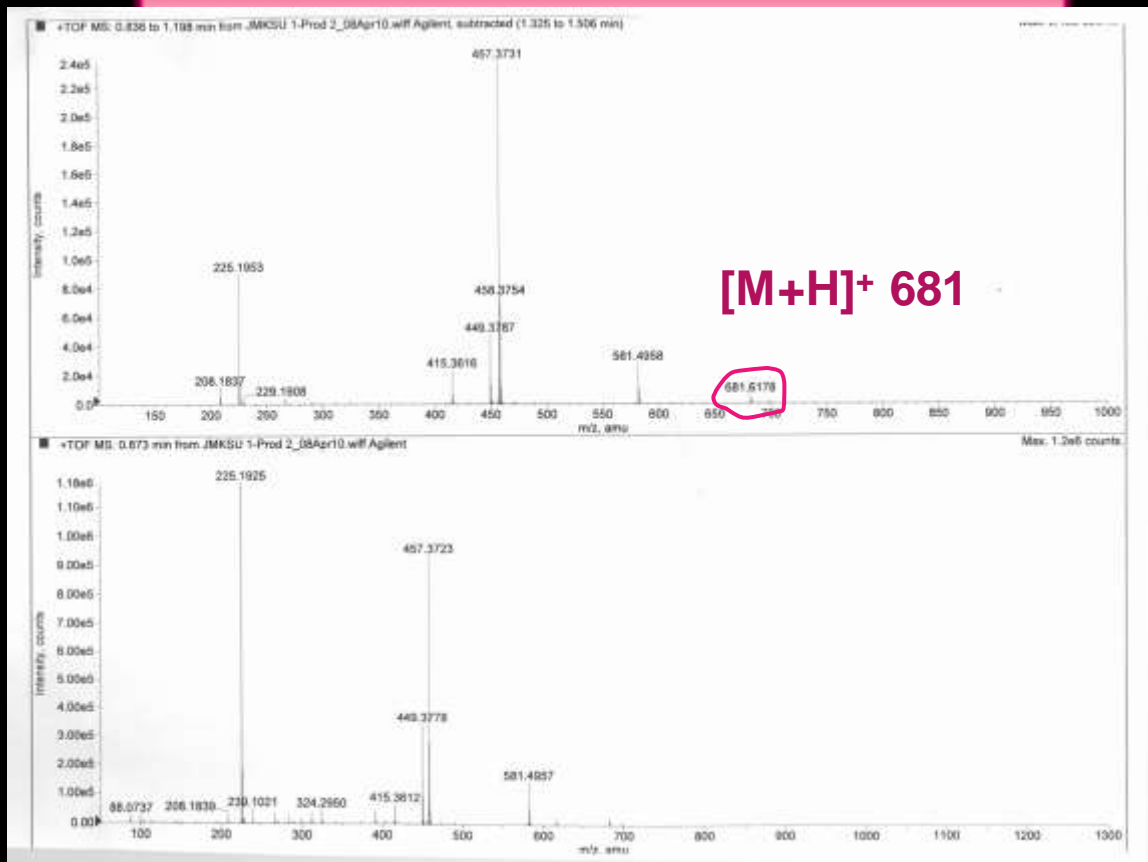


S-11c (3-N-octadecanoate-solanopubamine)



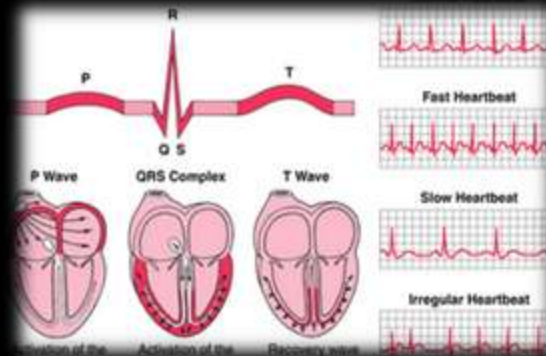


S-11d (23-O-octadecanoate-solanopubamine)





Biological Study of *Barbeya oleoides* Schweinf and *Solanum* *schimperianum* Hostch



Antimicrobial activity

a. Antimicrobial screening by determination of zone of inhibition

Sample:

b. Determination of minimum inhibitory concentration (MIC)

Method : Mitscher *et al.*

Results of antimicrobial screening of extracts (1 mg/ml) *B. oleoides* Schweinf

Micro-organism	Inhibition zone									
	Leave					Stem				
	Petroleum ether extract	Chloroform extract	Ethyl acetate Extract	Butanol extract	Aqueous Extract	Petroleum ether extract	Chloroform Extract	Ethyl acetate extract	Butanol extract	Aqueous extract
<i>Bacillus subtilis</i>	+	+	+	-	-	+	-	+	+	-
<i>Staphylococcus aureus</i>	+	-	+	+	+	+	-	+	+	-
<i>Escherichia coli</i>	-	-	-	-	-	-	-	+	-	-
<i>Pseudomonas aeruginosa</i>	-	-	+	+	-	-	-	+	+	-
<i>Mycobacterium smegmatis</i>	-	-	+	+	+	-	-	+	+	-
<i>Candida albicans</i>	-	-	+	+	+	+	-	+	+	-

MIC values of isolates B-2, B-3 and B-14 & B-15

Micro-organism	MIC in µg/ ml		
	B-2	B-3	B-14&B-15
<i>Bacillus subtilis</i>	50	25	25
<i>Staphylococcus aureus</i>	50	25	25

B-2 (Ursolic acid)

B-3 (Corsolic acid)

B-14&15 (Gallocatechin and epigallocatechin)

Results of antimicrobial screening of isolates B-2, B-3 and B-14& B-15 (100µg/ ml).

Micro-organism	Zone inhibition		
	B-2	B-3	B-14& B-15
<i>Bacillus subtilis</i>	+ ✓	+ ✓	+ ✓
<i>Staphylococcus aureus</i>	+ ✓	+ ✓	+ ✓
<i>Escherichia coli</i>	-	-	-
<i>Pseudomonas aeruginosa</i>	-	-	-
<i>Mycobacterium smegmatis</i>	-	-	-
<i>Candida albicans</i>	-	-	-

Results of antimicrobial screening of extracts (1 mg/ml) *S. schimperianum* Hochst

Micro-organism	Inhibition zone		
	<i>n</i> -hexane	Ethyl acetate Extract	Ethanol extract
<i>Bacillus subtilis</i>	+ ✓	–	+ ✓
<i>Staphylococcus aureus</i>	+ ✓	–	+ ✓
<i>Escherichia coli</i>		–	+ ✓
<i>Pseudomonas aeruginosa</i>	–	–	–
<i>Mycobacterium smegmatis</i>	–	–	+ ✓
<i>Candida albicans</i>	–	–	+ ✓



Results of MIC values of isolates compound S-11 from *S. schimperianum* Hostch

Micro-organism	MIC in µg/ ml of S-8
<i>Klepsiella pneumonia</i>	> 125.00 µg/ml
<i>Acinetobacter baumannii</i>	✓ > 31.25 µg/ml
<i>Escherichia coli</i>	> 62.50 µg/ml
<i>Pseudomonas aeruginosa</i>	✓ > 31,25 µg/ml
<i>Enterobacter</i>	> 62.50 µg/ml
<i>Methacilin resistant</i>	> 62.50 µg/ml
<i>Staphylococcous aureus</i>	
<i>Streptococcus pneumonia</i>	> 62.50 µg/ml
<i>Enterococcus faecalis</i>	> 62.50 µg/ml
<i>Enterococcus cloace</i>	> 62.50 µg/ml
<i>Staphylococcus epidermidis</i>	> 62.50 µg/ml
<i>Candida krusei</i>	> 125.00 µg/ml
<i>Aspergillus fumigatus</i>	> 126.00 µg/ml

S-11 (Solanobupamine)

Results of antimicrobial screening of isolates S-13, S-14 , and S-15 (100µg / ml). *S. schimperianum* Hostch

Micro-organism	Zone inhibition		
	S-13	S-14	S-15
<i>Bacillus subtilis</i>	–	–	–
<i>Staphylococcus aureus</i>	–	–	–
<i>Escherichia coli</i>	+ ✓	+ ✓	+ ✓
<i>Pseudomonas aeruginosa</i>	–	–	–
<i>Mycobacterium smegmatis</i>	–	–	–
<i>Candida albicans</i>	+ ✓	+ ✓	+ ✓

S-13 (1-{1-[2-(2 hydroxypropoxy) propoxy] propan-2-yloxy} propan-2-ol

S-14 (stearamide)

S-15 (6*E*, 9*E*-*N,N*-dimethyloctadeca-6,9-dienamide)

Results of antimicrobial screening of the synthetic compounds S-11a, S-11c and S-11d (100 µg / ml) from *S. schimperianum* Hostch

Micro-organism	Zone inhibition		
	S-11a	S-11c	S-11d
<i>Bacillus subtilis</i>	–	–	–
<i>Staphylococcus aureus</i>	–	–	–
<i>Escherichia coli</i>	+ ✓	+ ✓	+ ✓
<i>Pseudomonas aeruginosa</i>	–	–	–
<i>Mycobacterium smegmatis</i>	–	–	–
<i>Candida albicans</i>	+ ✓	+ ✓	+ ✓

S-11a (3-*N*,23-*O*-diacetyl-solanopubamine)

S-11c (3-*N*-octadecanoate-solanopubamine)

S-11d (23-*O*-octadecanoate-solanopubamine)

Antihypertensive activity

Animal: Male Wistar rats

Method: K. E. H. El Tahir

Changes in blood pressure were quantified in mm Hg using the calibration system built-in the physiograph

Changes in the heart rate were calculated as percentage change compared with the pre-drug level.

Effect of ethanol extracts of *B. oleoides* Schweinf on arterial blood pressure and heart rate.

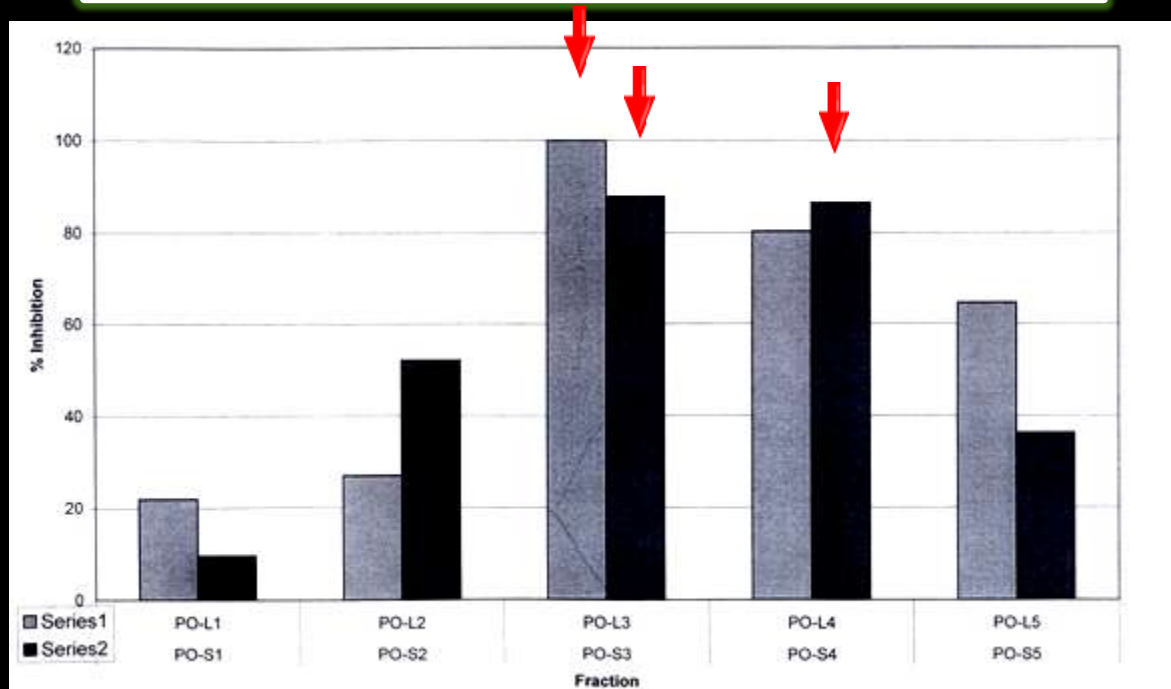
Ethanol extract Dose	Decrease in arterial blood pressure (mm Hg)	Percentage decrease in heart rate
10 mg/Kg(I.P)	18 mm Hg	0
50 mg/ kg (I.P)	54 mm Hg	0

Antioxidant activity

Sample: different fractions of *B. oleoides*

Method : Thin –Layer Densitometry adopted to E. A. Abourashed, 2005 using DPPH.

Inhibition of DPPH by different fractions of *B.oleoides* Schweinf at 25ug/ml



PO-L3 Ethyl acetate extract of leave
PO-L3 Ethyl acetate extract of stem
PO-S4 Butanol extract of stem

Spasmolytic activity

Effect of the different extracts on the spontaneously contracting rabbit jejunum.

Extract	% Inhibitor
BOB-S	65%
BOB-L	76%
Aqueous stem	55%
Ethyl acetate stem	80% ✓
Butanol stem	77%
Chloroform stem	92% ✓
Petroleum ether stem	68,2%

Effect of tested compounds on the spasmogens-induced contractions on isolated guinea-pig ileum:

Compound dose(100 µg/ml)	Inhibition %		
	Acetylcholine	Histamine	BaCl₂
B-13&14	0	0	0
B-4	0	25	72
B-5	0	0	83
B-12	18	22	50
B-1	66 ✓	35 ✓	0 ✓

B-13&14 (Gallicocatechin & epigallocatechin

B-4 (arjulonic acid)

B-5 (β -Sitosterol -3- β -O-glucoside)

B-12 (Borinisitol)

B-1 (Uvaol diacetate)

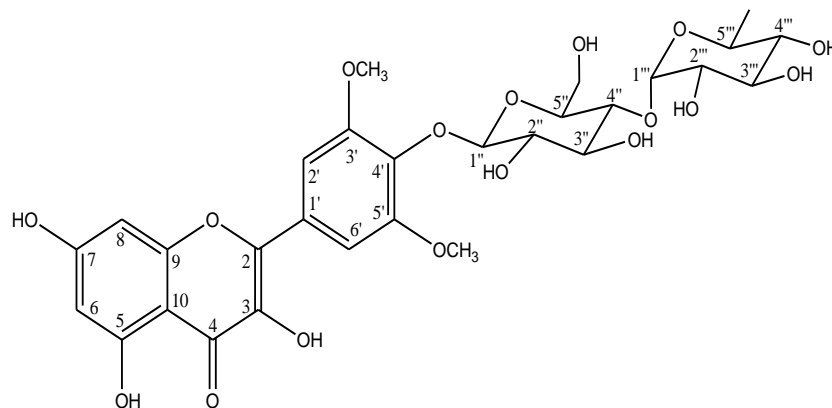
Conclusion

This study is the first one that deals with phytochemical and antimicrobial activity of *B. oleoides* Schweinf and *S. schimperianum* Hochst growing in Saudi Arabia

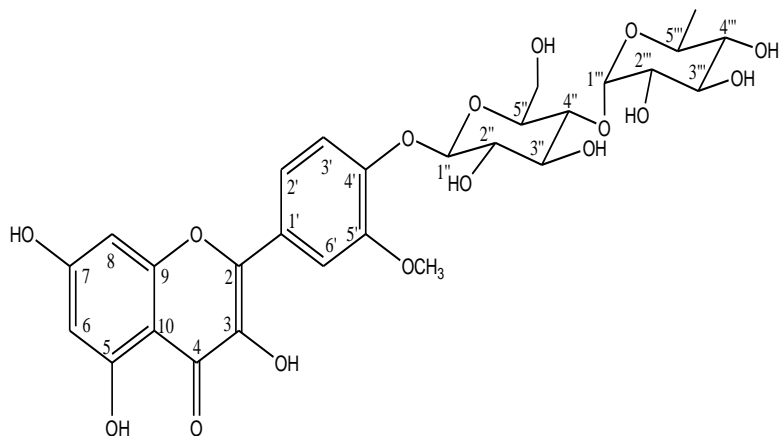
Phytochemical study of *B. oleoides* Schweinf resulted in isolation and characterization of 14 compounds

Phytochemical study of *S. schimperianum* Hochst resulted in isolation and characterization of 15 compounds

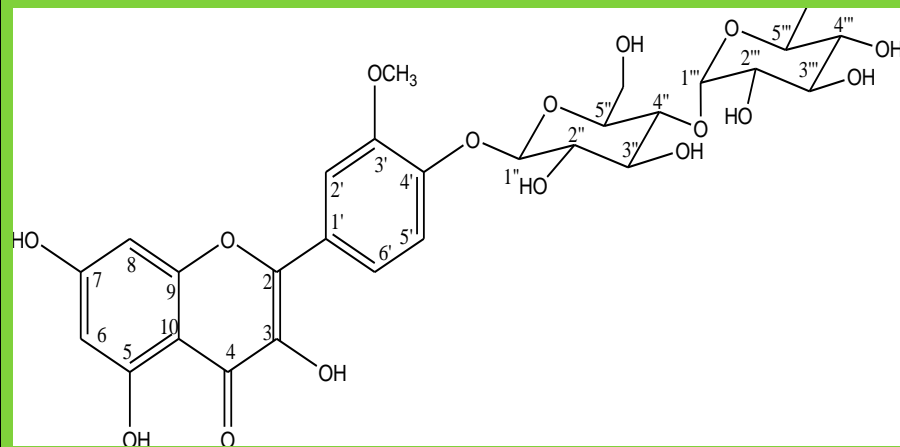
From *B. oleoides*, two compounds were isolated for first time from nature: B-10 and inseparable mixture of two isomeric compound B-11a & B-11b



B-10-(4'-O-[1''-4'']- rhamnopyranosyl) - β -O-D-glucopyranosyl, 3',5' dimethoxyquercetin)

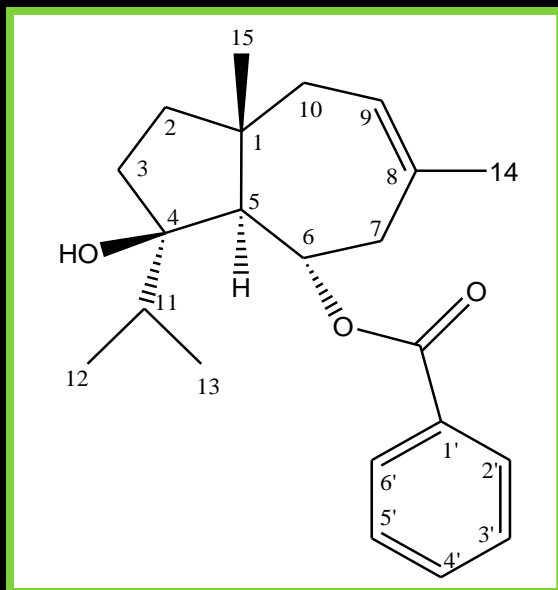


B-11b (4'-O-[1''-4'']-rhamnopyranosyl - β -O-D-glucopyranosyl-5'-methoxyquercetin)

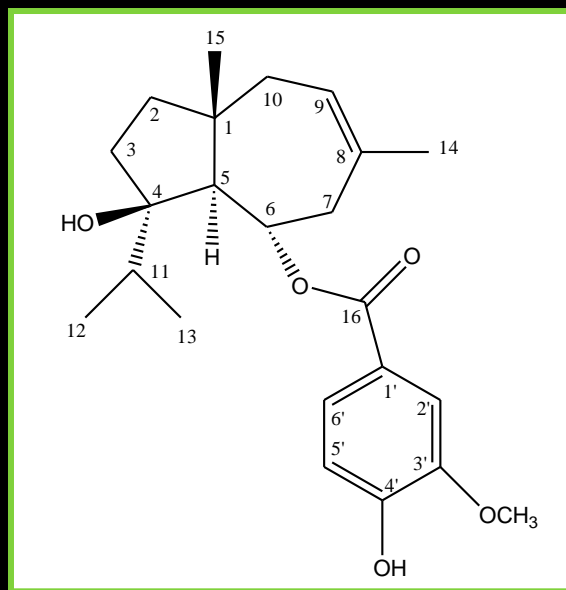


B-11a (4'-O-[1''-4'']-rhamnopyranosyl- β -O-D-(glucopyranosyl-3'-methoxyquercetin)

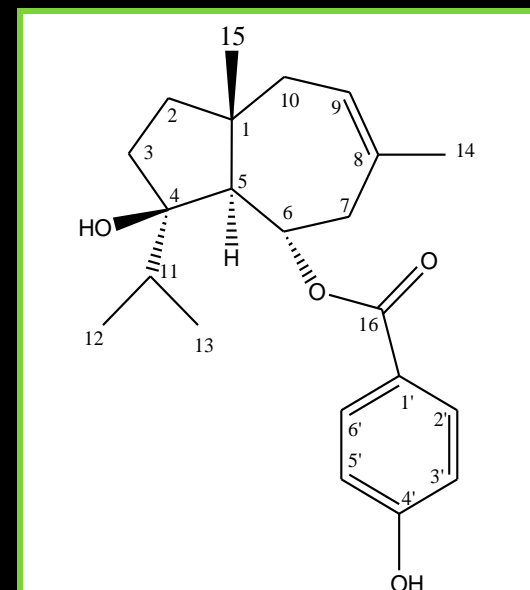
It was the first time to isolate Teferidin, teferin , ferutinin ,stearamide and 6*E*,9*E*-*N,N*-dimethyloctadeca- 6,9-dieneamide from family solanaceae



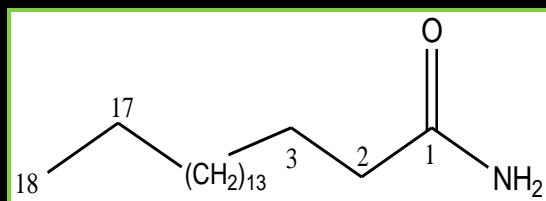
S-5 (Teferidin)



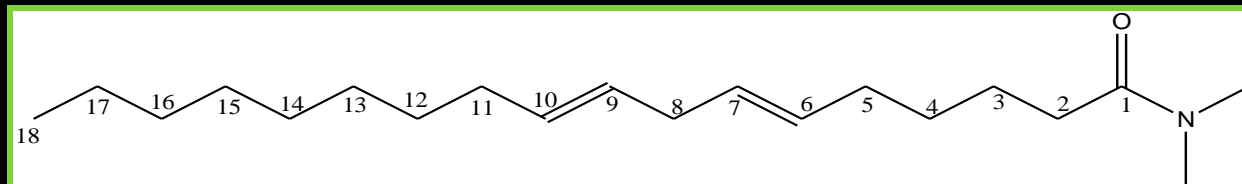
S-6 (Teferin)



S-7 (Ferutinin)

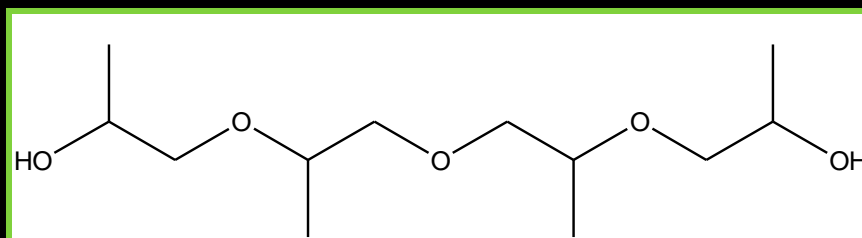


S-14 (Stearamide)

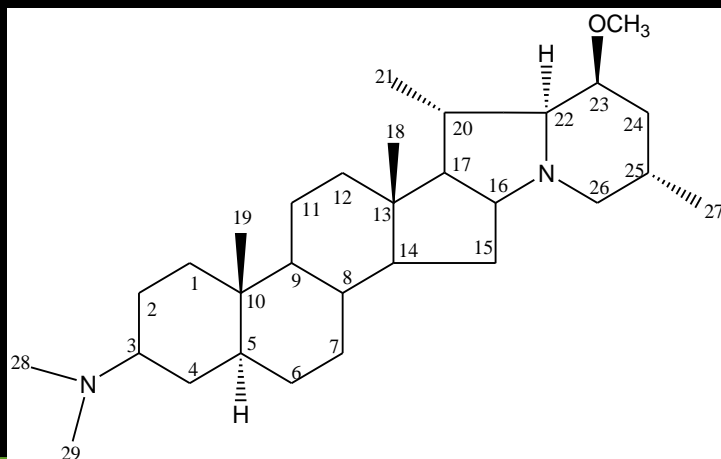


S-15 (6*E*,9*E*)-*N,N*-dimethyloctadeca-6,9-dieneamide

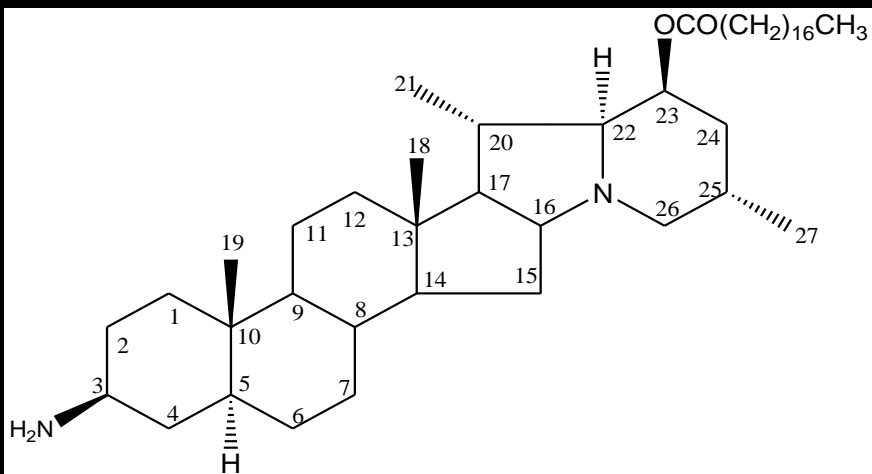
It was the first time to isolate 1-{1-[2 (2hydroxypropoxy) propoxy] propan-2-yloxy} propan- 2-ol] from nature



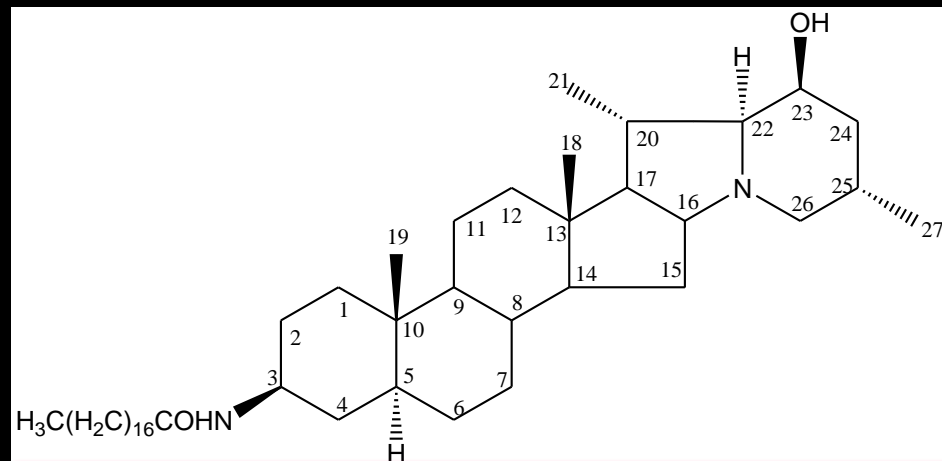
It was the first time to synthesis 3,3-*N,N*-Dimethyl-23-*O*-methylsolanopubamine , 3-*N*-octadecanoate-solanopubamine and 23-*O*-octadecanoate-solanopubamine



S-11b (3,3-*N,N*-Dimethyl-23-*O*-methylsolanopubamine)

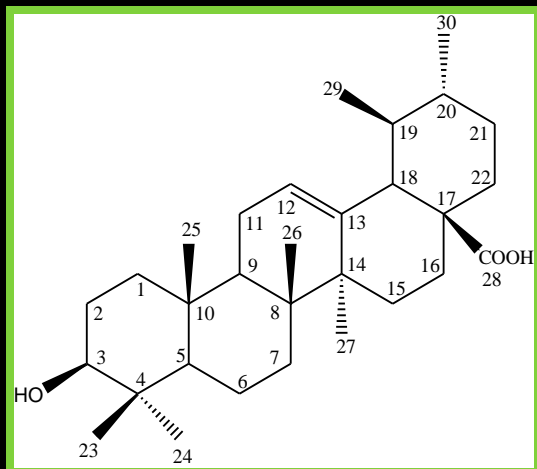


S-11d (23-*O*-octadecanoate-solanopubamine)

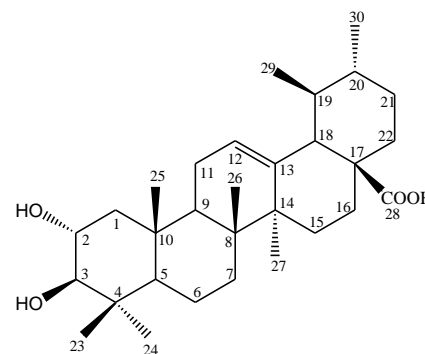


S-11c (3-*N*-octadecanoate-solanopubamine)

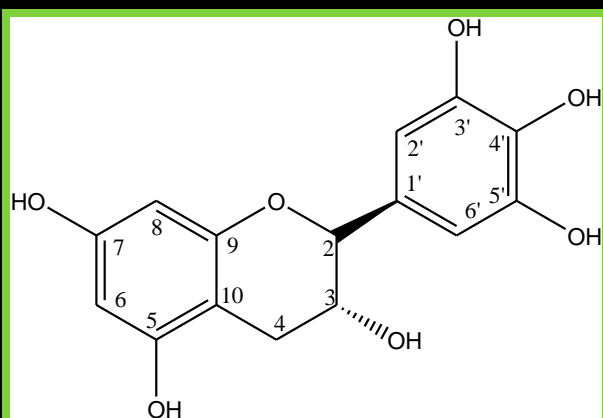
From *B. oleoides*: Ursolic acid (B-2), Corsolic acid (B-3) and galocatechin epimer (B-13 & B-14) showed good antimicrobial activity



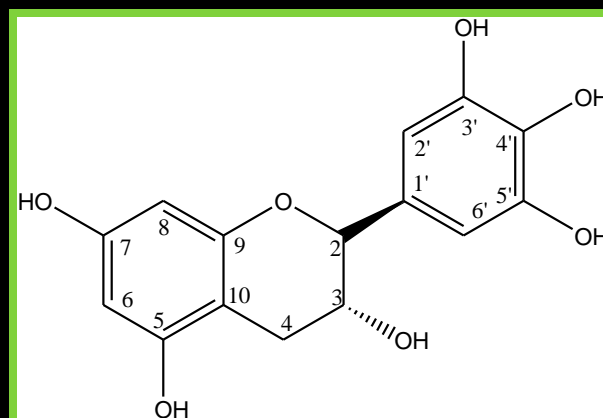
B-2 (Ursolic acid)



B-3 (Corsolic acid)

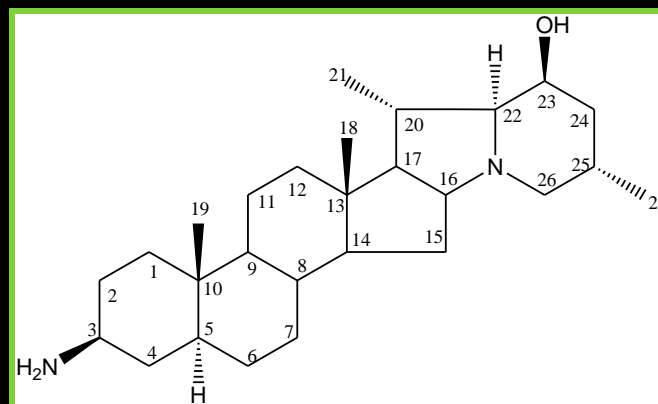


B-14 (Epigallocatechin)

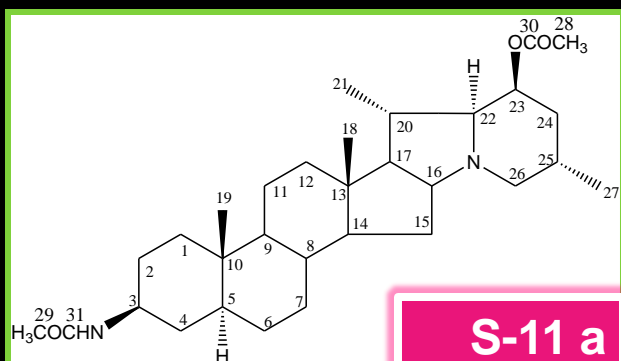


B-13 (Galocatechin)

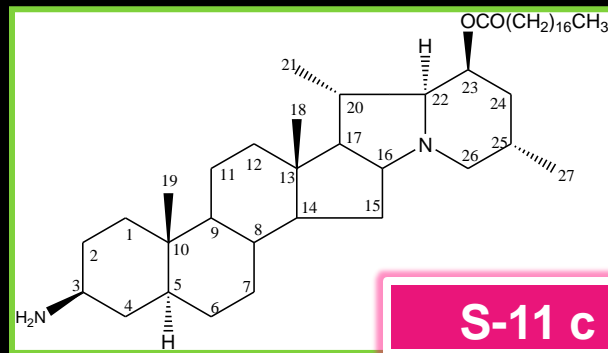
From *S. schimperianum* : S-11 and its synthetic compounds S-11a, S-11c and S-11d showed good antimicrobial activity



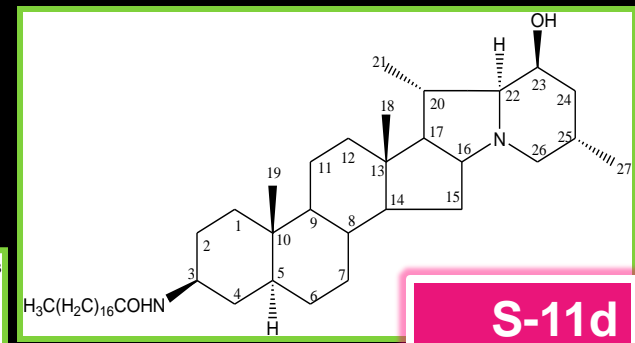
S-11 (Solanopubamine)



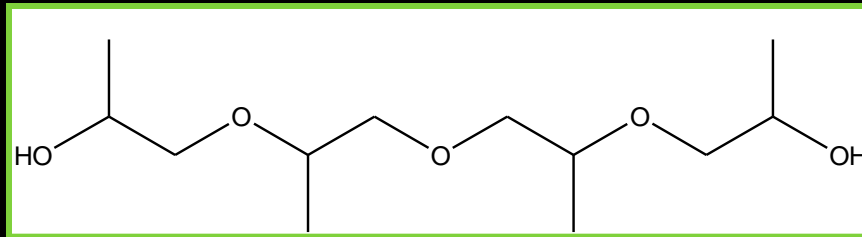
S-11 a



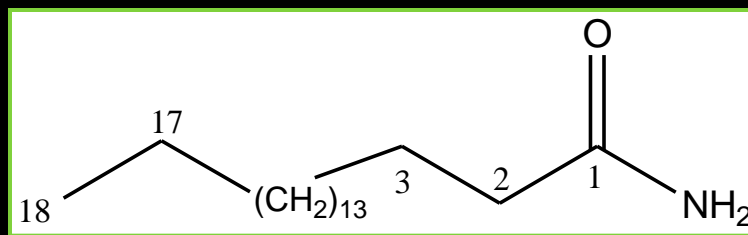
S-11 c



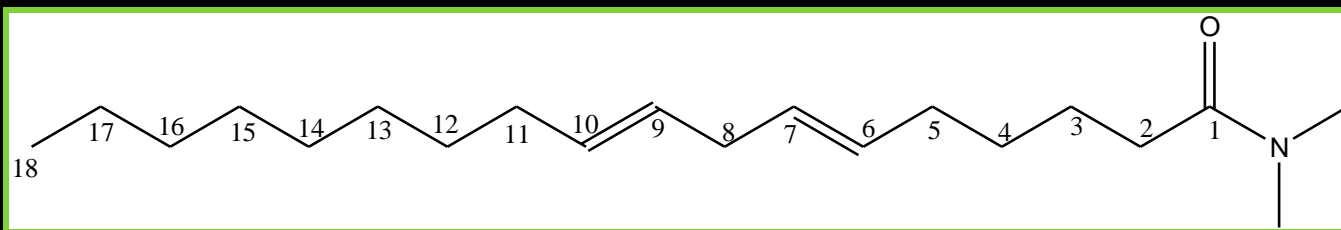
S-11 d



S-13 (1-{1-[2-(2 Hydroxypropoxy) propoxy] propan-2-yloxy} propan-2-ol)

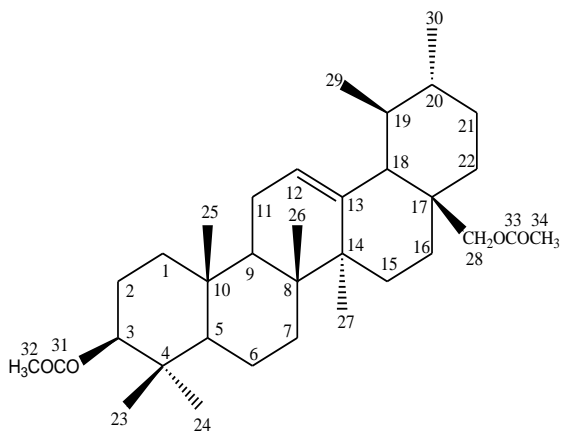


S-14 (Stearamide)

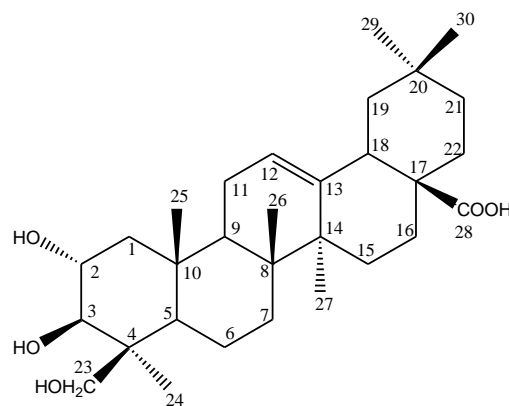


S-15 (6*E*,9*E*)-*N,N*-dimethyloctadeca-6,9-dieneamide

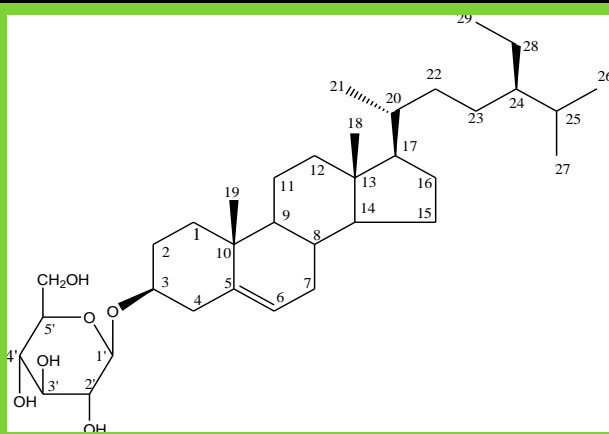
Isolated compounds : B-1, B-4, B-5 and B-12 from *B. oleoides* showed spasmolytic activity



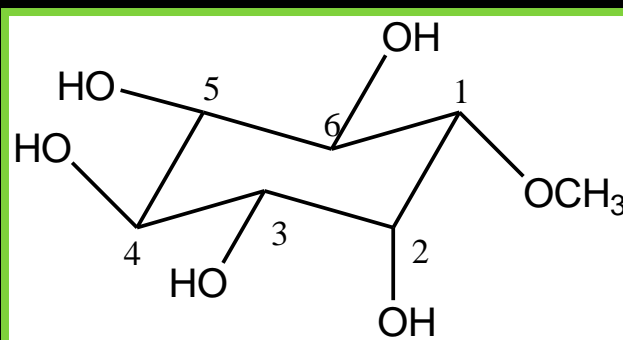
B-1 (Uvaol diacetate)



B-4 (Arjunolic acid)



B-5 (β-sitosterol-3-O-β-D-glucoside)



B-12 (D (-) bornesitol)

Ethanol extract from *B. oleoides* possess antihypertensive activity

Ethyl acetate and butanol extracts from *B. oleoides* showed marked antioxidant activity



Thank you