REVIEW ARTICLE

RECORDS OF PHARMACEUTICAL AND BIOMEDICAL SCIENCES

Triterpenoid and Triterpenoid Saponins from Genus *Mimusops*: A Review

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Abstract

Mimusops genus, the most important and biggest genus of family Sapotaceae comprising of approximately 57 species, is native to tropical and subtropical regions of Asia, Africa, Australia, and various oceanic islands. Some species of which have been usually used in traditional medicine for thousands of years. Some species of this genus can also be used in green synthesis of gold and silver nanoparticles, dye industry for cotton and silk fabrics and other applications. The triterpenoid saponins, as one of the most important bioactive components of the *Mimusops* genus, have attracted the attention of the scientific community. Thus, a comprehensive and systematic review on triterpenoid saponins and triterpenoids/sterols from the genus is indispensable. In this review, a total of twenty-eight and thirty-seven triterpenoid saponins and triterpenoids/sterols respectively, from the genus *Mimusops* together with their pharmacological activities including anti-inflammatory, anti-oxidant, hepatoprotective, anti-bacterial, antiulcer, anti-cancer, cytotoxicity, anti-convulsion, anti-pyretic, anti plasmodial, antiurolithiatic and hypoglycemic effects were summarized.

Keywords: *Mimusops*; pharmacological; triterpenoid saponins and triterpenoids/sterols.

1. Introduction

Herbal medicine served as a medicinal method for diseases destroying humanity. About 50,000 plant species are stated to have medicinal properties (Barboza et al., 2009). In ancient history, several drugs have been from plant sources as a natural ′ s gift to human beings to make disease-free healthy life, and play a vital role in maintaining our health. Now, the basis of modern medicinal drugs such as vancomycin, maribavir, avacopan and atogepant were synthesized through scientific validation of herbal medicine (Benedetto Tiz et al., 2022).

Plants contain nutrients and beneficial part such as fruit, herb and gum, etc…used by humans for medicinal and other cultural purposes. Even today, the World Health Organization (WHO) estimates that up to 80% of the world's population especially those living in the developing world still rely on natural products as a main source of health maintenance and practice of traditional medicine which includes the use of herbs as an essential part of their culture (Bandaranayake, 2006). The use of herbal products increasing due to their cultural availability, acceptability, affordability, efficacy and safety. On the other hand awareness of plant-based drugs advanced gradually for maintaining good health has been widely observed by UNESCO (Dubey et al., 2023).

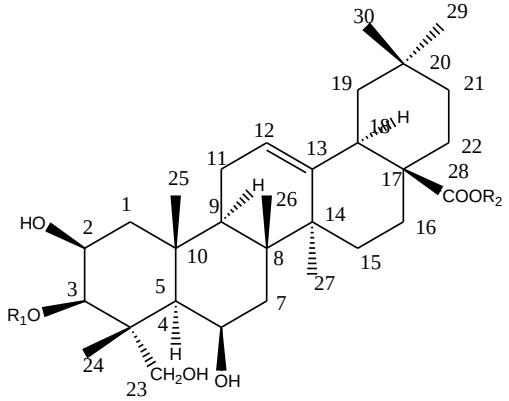
Mimusops genus, the most important and biggest genus of family Sapotaceae, is native to tropical and subtropical regions of Asia, Africa, Australia, and various oceanic islands (Abdelmohsen et al., 2020). In traditional medicine, certain plants of this genus are diffusely applied in the treatment of dysentery, diarrhea, wounds, sores, headache, asthma, biliousness, febrile disease and sexually transmitted infections (STIs), especially gonorrhea and candidiasis (Kadam et al., 2012, Mishra and Pareek, 2014, Barboza et al., 2009). Some species of this genus can also be used in green synthesis of gold and silver nanoparticles, dye industry and other applications (Biswal et al., 2021, Hossain et al., 2021, Omotayo et al., 2020).

Triterpenoid saponins are an important class of bioactive compounds in genus *Mimusops* and their structures are mainly oleananes with 1–4 saccharide groups at C-3 and/or C-28 position, thereby forming monosaccharide or disaccharide chains. In our review triterpenoid saponins reported from *Mimusops* plants are mostly of protobassic acid and 16α-hydroxy protobassic acid derivatives attached with sugar side chains. Besides, the most frequently attached sugar units are rhamnose and glucose. To date, a total of twenty-eight triterpenoid saponins have been isolated from genus *Mimusops*. The saponins in *Mimusops* are mainly pentacyclic triterpenoids. According to different sapogenins, the saponins are divided into three categories: oleanolic acid, hederagenin and ursolic acid. Sapogenins are often linked to various monosaccharides at positions 3 or (and) 28 to form glycosides. Most of these monosaccharides are D-glucose, L-arabinose (pyranose). The structure of triterpenoid saponins from various *Mimusops* species are presented in table 2.1. On the other hand, triterpenoids/sterols reported from *Mimusops* plants are mostly of ursolic acid, alpha and beta-amyrin derivatives and are presented in table 2.2. The reported health effects of *Mimusops* plants in folk medicine in relation to their bioactive triterpenoid saponins and triterpenoids/sterols were also reviewed with special attention to anti-inflammatory, antiulcer activity, antibacterial activity, cytotoxic, anti-hypercholesterolemic, antioxidant, and hypoglycemic activities (Lim and Lim, 2013, HA et al., 2019). In this review, data were acquired using Google Academic Search, PubMed and Reaxys. The studies on triterpenoids and their glycosides, biological activities and pharmacological effects, of genus *Mimusops* were summarized in table 3, and this review provided a reference for the comprehensive utilization of triterpenes and their glycosides reported from genus *Mimusops*.

2. Chemical constituents reported from genus *Mimusops*:

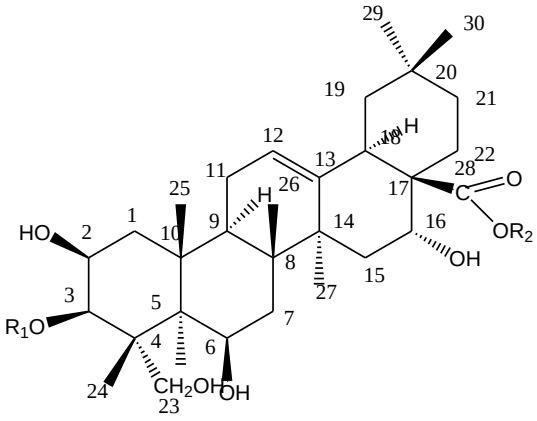
It was reported that triterpenoid saponins and other pentacyclic triterpenoids in addition to sterols were isolated and identified from genus *Mimusops* and are summarized in table (2.1 and 2.2).

Table (2.1). Triterpenoid saponins isolated from different plants of genus *Mimusops*

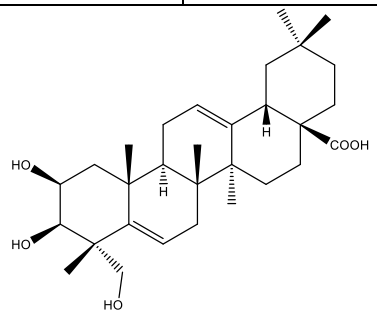
Compound name	Strucure	Plant name	Plant part	Reference
I-Triterpenoidal saponins				
				

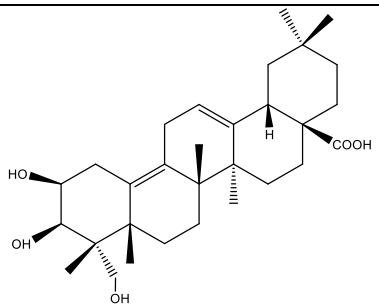
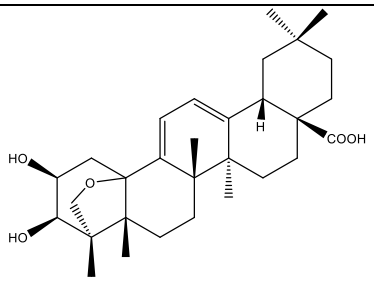
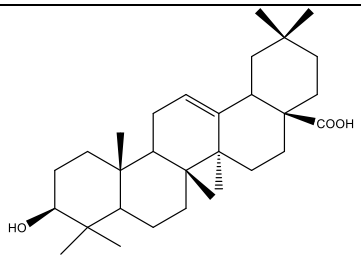
	R_1	**R_2**			
Protobassic acid	H	H	*M. elengi L.*	Seeds	(N. Sahu, 1996)
Butyroside C	GluA	Rham-(1→3)-Xyl(1→4) Rham(1→2)-Ara	*M. elengi L. / M. hexandra Roxb.*	Seed kernel	(Lavaud, Massiot, Becchi, Misra, & Nigam, 1996)
			M. laurifolia (Forssk.) Friis	Seeds	(Eskander et al., 2006)
Arganine D	Glc (1→6) Glc	Rham-(1→3)-Xyl(1→4) Rham(1→2)-Ara	*M. laurifolia (Forssk.) Friis*	Seeds	(Eskander et al., 2006)
Mimusin	Glc (1→6) Glc	Rham-(1→3)-Xyl(1→4) Rham(1→2)-Ara	*M. elengi L.*	Seeds	(N. P. Sahu, Koike, Jia, & Nikaido, 1997)
			M. elengi L.	Seeds	(N. Sahu, Mandal, Banerjee, & Siddiqui, 2001)
Mi-Saponin A	Glc	Rham-(1→3)-Xyl(1→4) Rham(1→2)-Ara	*M. elengi L.*	Seeds	(N. Sahu et al., 2001)
			M. laurifolia (Forssk.) Friis	Seeds	(Eskander et al., 2006)
			M. elengi L.		
			M. hexandra Roxb.	Seed kernel	(Lavaud et al., 1996)
			M. manilkara		

			G.Don		
Sideroxyloside A	Glc	Rham-(1→3)-Xyl(1→4)Rham(1→2)Xyl	*M. laurifolia (Forssk.) Friis*	-	(Eskander et al., 2005)
Mimusopsin	Glc (1→3) Glc	Rham-(1→3)-Xyl(1→4)Rham(1→2)-Ara	*M. hexandra Roxb. /* *M. manilkara G.Don* *M. elengi L.* *M. elengi L.*	Seed kernel Seeds Seeds	(Lavaud et al., 1996) (N. P. Sahu et al., 1997) (N. Sahu et al., 2001)
Mimusopin	Glc	Rham-(1→3)-Xyl- [(1→3) Rham] - (1→4) Rham(1→2) Ara	*M. elengi L.* *M. elengi L.*	Seed kernel Seeds	(Lavaud et al., 1996) (N. Sahu et al., 2001)
Mimusopside A	Glc	Rham(1→2)-Ara	*M. elengi L.*	Seeds Seeds Fruit and seeds	(N. Sahu, 1996) (N. Sahu et al., 2001) (Kadam, Yadav, Deoda, Shivatare, & Patil, 2012)
Mi-glycoside I	Glc	H	*M. elengi L*	Seeds	(N. Sahu, 1996) (N. Sahu et al., 2001)
Methyl ester of mi-glycoside	Glc	CH3	*M. elengi L*	Seeds	(N. Sahu, 1996)



	R_1	**R_2**			
16α-Hydroxy Protobassic acid	H	H			
Arganine K	Glc (1→3) Glc	Rham-(1→3)Xyl(1→4) Rham(1→2)-*A*-L-Ara	*M. laurifolia (Forssk.) Friis*	Seeds	(Eskander et al., 2006)
Arganine A	Glc (1→6) Glc	Rham-(1→3)-Xyl(1→4) Rham(1→2)-Ara	*M. laurifolia (Forssk.) Friis*	Seeds	(Eskander et al., 2006)
Arganine C	Glc	Rham-(1→3)-Xyl(1→4) Rham(1→2)-Ara	*M. laurifolia (Forssk.) Friis* *M. elengi L.*	Seeds Seed kernel	(Eskander et al., 2006) (Lavaud et al., 1996)
Tieghemelin A	GluA	Rham-(1→3)-Xyl(1→4)Rham(1→2)-Ara	*M. laurifolia (Forssk.) Friis*	Seeds	(Eskander et al., 2006)
Mimusopside B	Glc	Rham(1→2)-Ara	*M. elengi L.*	Seeds	(N. Sahu, 1996) (N. Sahu et al., 2001)

				Fruit and seeds	(Kadam et al., 2012)
Elengin	Glc (1→6) Glc	Rham-(1→3)-Xyl(1→4) Rham(1→2)-Ara	*M. elengi L.*	Seeds	(N. Sahu et al., 2001)
16α -hydroxy-mimusopside saponin	Glc	Rham-(1→3)-Xyl(1→4) Rham(1→2)-Ara	*M. elengi L.*	Seeds	(N. Sahu et al., 2001)
3-O-*β* -D-glucoside-16α-Hydroxy Protobassic acid	Glc	H	*M. elengi L.*	Seeds	(N. Sahu et al., 2001)
Prosapogenin	Glc	H	*M. elengi L*	Seeds	(N. Sahu, 1996)
3-O-(β –D-glucuronopyranosly) 28-O-(α -L-Rhammnopyranosyl(l → 3) β -D-xylopyranosyl(1 → 4) - α L-Rhammnopyranosyl(1→ 2) α –L-arabinopyranosyl) 16 -α -hydroxyprotobassic acid.	Glc	Rham-(1→3)-Xyl(1→4) Rham(1→2)-Ara	*M. hexandra Roxb.*	Seed kernel	(Lavaud et al., 1996)
Bassic acid			*M. elengi L.* *M. elengi L.* *M. manilkara G.Don*	Seed Bark *Seed* kernel	(N. Sahu, 1996) (Roqaiya, Begum, Majeedi, & Saiyed, 2015) (Misra, Nigam, &

		M. hexandra Roxb. *M. elengi L.* *M. heckeli* *M. djave Engl.*		Mitra, 1974)
Mimusopic acid		*M. elengi L.*	Seeds	(N. Sahu, 1996) (Roqaiya et al., 2015)
Mimusopsic acid		*M. elengi L.*	Seeds	(N. Sahu, 1996) (Roqaiya et al., 2015)
Oleanolic acid		*M. laurifolia (Forssk.) Friis* *M. hexandra Roxb.* *M. elengi L.* *M. manilkara G.Don*	Leaves Seed kernel saponi	(Hifnawy et al., 2012) (Misra et al., 1974)

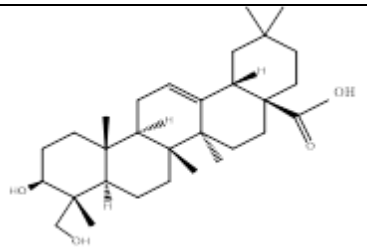
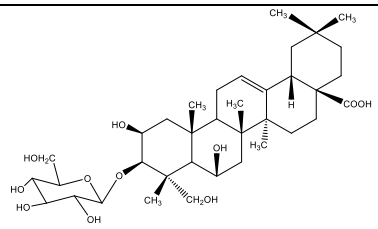
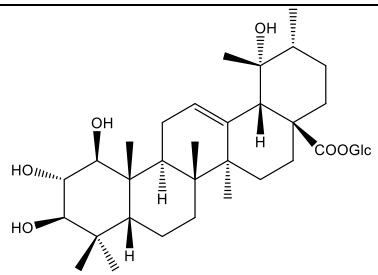
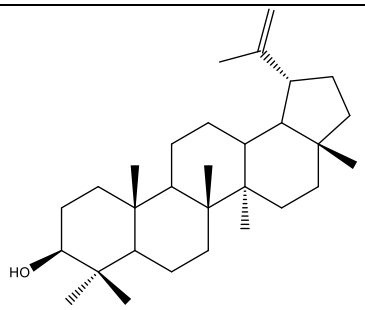
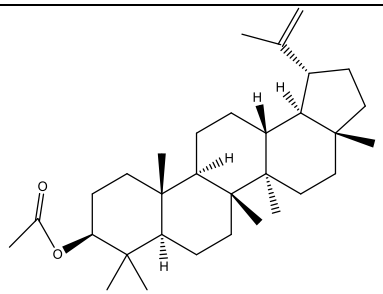
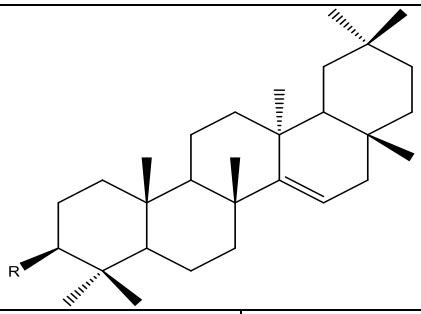
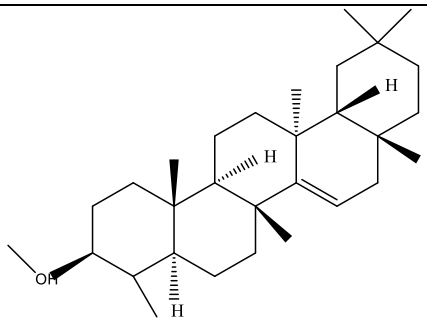
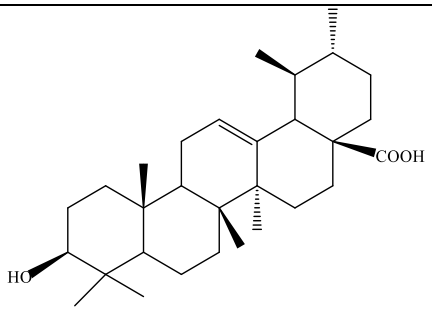
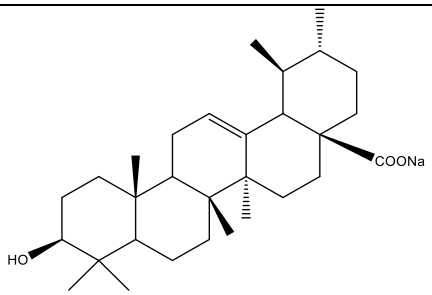
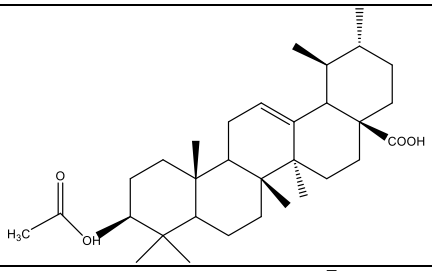
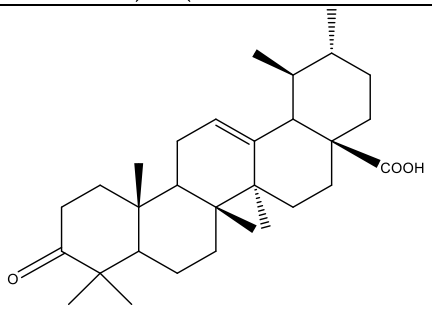
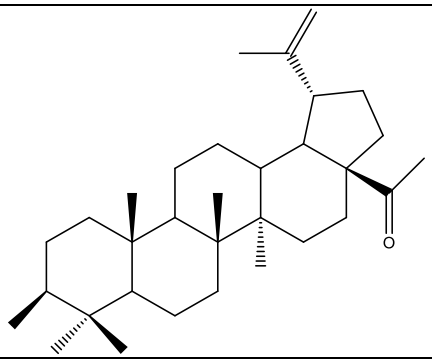
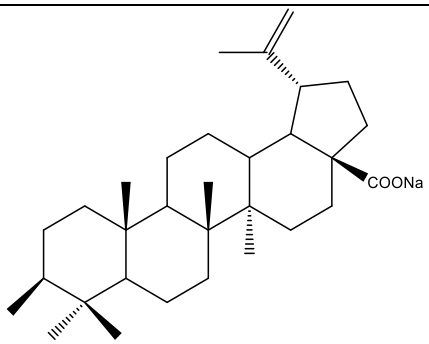
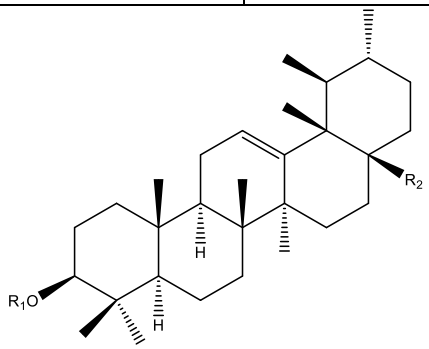
Hederagenin		*M. hexandra Roxb.* *M. elengi L.*	Seed kernel Heartwood and seed kernel	(Misra et al., 1974)
3-O-β-D-glucuronopyranoside		*M. elengi L.*	Bark and seed	(Suedee, 2012)
l β, 2α, 3β, 19 α -tetrahydroxyursolic acid 28-O- β -D-glucopyranosi		*M. hexandra Roxb.*	Stem bark	(Srivastava & Singh, 1994)

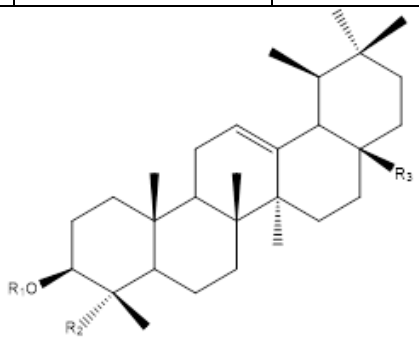
Table (2.2). Triterpenoids/sterols isolated from different plants of genus *Mimusops*

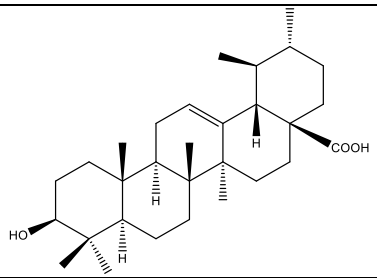
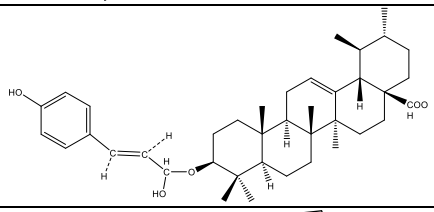
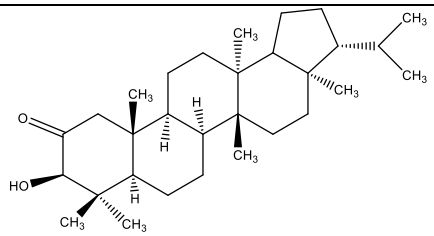
Compound name	Strucure	Plant name	Plant part	Reference
II- Triterpenoids/sterols				
Lupeol		*M. elengi L.*	The shade-dried plant	(Jahan, Ahmed, & Malik, 1995a)
Lupeol acetate		*M. laurifolia (Forssk.) Friis* *M. elengi L.*	Leaves Root	(Hifnawy et al., 2012) (Roqaiya et al., 2015)

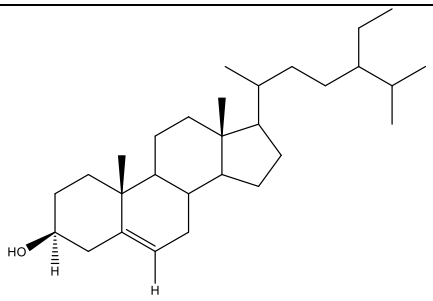
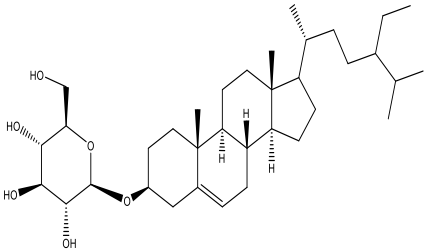
				
Taraxerone	R = O	*M. elengi L.* *M. manilkara G.Don*	Bark Bark	(Roqaiya et al., 2015) (Misra et al., 1974)
Taraxerol	R = OH	*M. elengi L.*	Stem bark and root	(Roqaiya et al., 2015)
Taraxeryl acetate	R = O.CO. CH_3	*M. hexandra Roxb.*	Bark	(Misra et al., 1974)
Taraxeryl methyl ether	R = OCH_3	*M. manilkara G.Don*	Bark	(Misra et al., 1974)
Sawamilletin		*M. obtusifolia Lam.*	Stem bark	(M. B. Simelane et al., 2013) (M. B. C. Simelane, 2014)

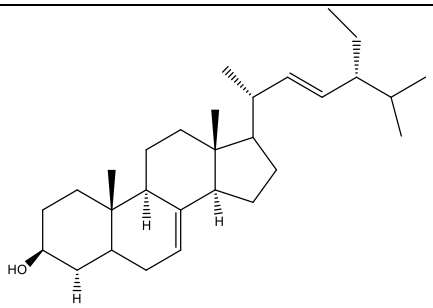
Ursolic acid		*M. elengi L.*	Bark	(Roqaiya et al., 2015)
Ursolic acid ester and sodium ursolate		*M. hexandra Roxb.* *M. elengi L.*	Fruit pulp Bark	(Misra et al., 1974)
3-Acetyl ursolic acid		*Mimusops caffra E.Mey. ex A.DC.*	Leaves	(M. B. Simelane et al., 2013) (M. B. C. Simelane, 2014)
3-oxo- ursolic acid		*Mimusops caffra E.Mey. ex A.DC.*	Leaves	(M. B. C. Simelane, 2014)
Betulinic acid		*M. elengi L.*	Bark	(Roqaiya et al., 2015)

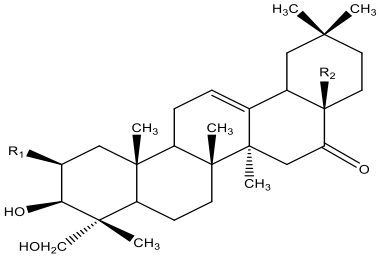
Sodium betulinate			*M. elengi L.*	Bark	(Misra et al., 1974)
					
	R_1	**R_2**			
Alpha-amyrin	H	CH_3	*M. laurifolia (Forssk.) Friis* *M. manilkara G.Don*	Leaves Bark	(Hifnawy et al., 2012) (Misra et al., 1974)
Alpha-amyrin acetate	$COCH_3$	CH_3	*M. hexandra Roxb.* *M. manilkara G.Don*	Fruit pulp Fruit pulp,bark and leaves	(Misra et al., 1974)
Alpha-amyrin caprylate	CH_3 $(CH_2)_6CO$	CH_3	*M. manilkara G.Don*	Fruit pulp	(Misra et al., 1974)
Alpha- arnyrin	CO.HC =	CH_3	*M.*	Bark and root	(Misra et al.,

cinnamate	$CH.C_6H_5$			*hexandra Roxb.*		1974)
						
	R_1	**R_2**	**R_3**			
Beta-amyrin	H	CH_3	CH_3	*M. elengi L.* *M. manilkara G.Don*	Bark Latex and bark	(Roqaiya et al., 2015) (Misra et al., 1974)
Beta-amyrin acetate	$COCH_3$	CH_3	CH_3	*M. globosa* *M. balata (Aubl.) C.F.Gaertn.* *M. hexandra Roxb.* *M. manilkara G.Don*	Dried gum Gum balata Fruit pulp Fruit pulp ,bark and leaves	(Misra et al., 1974)

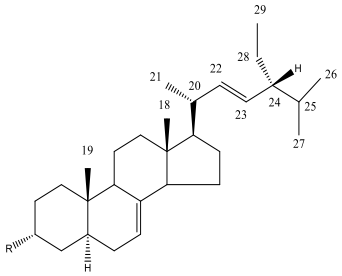
β-amyrin caprylate	$CH_3(CH_2)_6CO$	CH_3	CH_3	M. elengi L. *M. manilkara G.Don*	Bark Fruit pulp	(Rajkumara, Pandiselvi, & Sandhiya, 2012) (Misra et al., 1974)
β-arnyrin cinnamate	$CO.HC=CH.C_6H_5$	CH_3	CH_3	*M. hexandra Roxb.*	Root	(Misra et al., 1974)
Chondrillasterol				*M. laurifolia (Forssk.) Friis*	_	(Hifnawy et al., 2012)
Chondrillasterol-3-O-β-D-galactoside				*M. laurifolia (Forssk.) Friis*	Leaves	(Hifnawy et al., 2012)
3β-hydroxy-12-ursen-28-oic acid				*M. elengi L.*	Seeds	(Choudhary, 2001) (Gami, Pathak, & Parabia, 2012)
3β-(4-hydroxy cinnamoyl)-12-ursen-28-oic acid						
Mimusopfarnanol				*M. elengi L.*	Stem bark	(Nida Akhtar, Ali, & Alam, 2009)

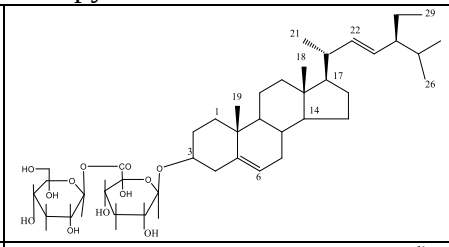
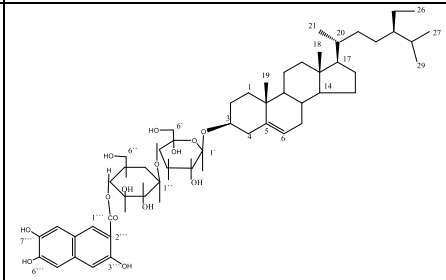
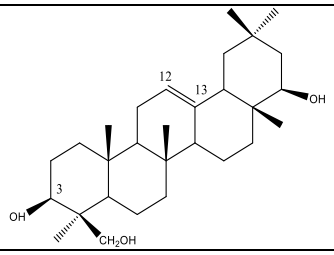
β-sitosterol		*M. elengi L.*	Seeds	(Roqaiya et al., 2015)
		M. hexandra Roxb.	Stem bark	(Srivastava & Singh, 1994)
β-Sitosterol-β-D-glucoside		*M. hexandra Roxb.*	Mesocarp and root.	(Misra & Mitra, 1968)
		M. elengi L.	Seed coat,kernel,bark,root and heartwood.	(Misra et al., 1974)
		M. manilkara G.Don	Seed coat, kernel and mesocarp.	(Misra & Mitra, 1969)
		M. elengi L.	Root and flower	(Roqaiya et al., 2015)

α-Spinasterol		*M. elengi L.*	Root and stem bark	(Roqaiya et al., 2015)
		M. hexandra Roxb.	Fruit pulp,root and kernel fat non sap.	(Misra et al., 1974)
		M. elengi L.	Bark, root,heartwood and kernel fat non sap.	
		M. manilkara G.Don	Fruit pulp and kernel fat non sap	



	R1	R2			
Mimusopgenone	OH	H	M. elengi L.	Seeds	(Sen, Sahu, & Mahato, 1995)
Mimugenone	H	CH3			



R= P-D-glUCOpyMOSyl 3-0- p-D-glucopyranoside		*M. elengi L.*	Shade dried plant	(Jahan, Ahmed, & Malik, 1995b)
R= P-D-gdactopyranosyl (24R)-stigmast-7,22(E)-dien-3a-o13- 0- P-D-galactopyranoside				
Stigmasterol--D-glycopyranoside		*M. elengi L.*	Stem bark	(N Akhtar, Ali, & Alam, 2010)
Sitosterol diglucosyl naphthoate				
Sapogenin As Steroids (C27) or triterpenoids (C30)		*M. elengi L.*	Bark	(Singh, Singh, & Singh, 2012)
5 alpha-stigmast-9(11) en-3-obeta-D-glucopyranosyl (1→5)-o-beta-Dxylofuranoside		*M. elengi L.*	Root	(Kadam et al., 2012) (Rani & Rahman, 2017) (Roqaiya et al., 2015)

2. Reported biological activities of different species in genus *Mimusops*

It was reported that triterpenoid saponins and other pentacyclic triterpenoids in addition to sterols and their derivatives were isolated and identified from different species of *Mimusops* genus showed different biological and pharmacological activities and are summarized in table (3).

Table (3). Reported biological activities of different species in genus *Mimusops*

Biological Activity	*Mimusops* Species	Part/Extract used	Relevant chemistry	Pharmacological action	Reference
Antiulcer	*M. elengi L.*	Bark	3 β , 6 β , 19 α , 23-tetrahydroxy-urs-12-ene / pentacylcic triterpene	Moderate inhibiting activity against β – glucuronidase enzyme associated with gastric ulcers	(Lim & Lim, 2013)
Anti-bacterial	*M. elengi L.*	Leaf /Chloroform extract : 1-Spinasterol 2-ursolic acid 3-3β, 6β, 19α, 23-tetrahydroxyurs-12-en-28-oic acid Bark /Chloroform extract: 4- taraxerol 5- spinasterol β-Dglucopyranoside	1-Spinasterol 2-ursolic acid 3-3β, 6β, 19α, 23-tetrahydroxyurs-12-en-28-oic acid 4- taraxerol 5-spinasterolβ-Dglucopyranoside	Spinasterol showed strong inhibitory effcts against *Staphylococcus aureus,Bacillus subtilis* and*Klebsiella pneuomoniae*, with MIC values of 9.7, 58 and 78 μg/mL, respectively. -3β, 6β, 19α, 23-tetrahydroxyurs-12-en-28-oic acid showed strong activity (78 μg/mL) against *Staphylococcus aureus* and moderate activity (156 μg/mL) against *Pseudomonas stutzeri*. Taraxerol showed strong activity (78 μg/ml) against Staphylococcus aureus. Spinasterol β-Dglucopyranoside showed moderate activity (175 μg/mL) against *Klebsiella pneuomoniae*.	(Amir, Wong, Eldeen, Asmawi, & Osman, 2013)

Hypoglycemic	*M. elengi L.*	Leaf extract/Methanolic extract	3 β -(*p* -hydroxy-trans -cinnamoyloxy)urs-12- en-28-oic acid and ursolic acid /triterpenes	Potent inhibitory activity against α -glucosidase enzyme. The enzyme a -glucosidase catalyzes the fi nal step in the digestive process of carbohydrates, and hence α a -glucosidase inhibitors could retard the absorption of glucose.	(Lim & Lim, 2013) (Lim & Lim, 2013)
		Seeds /Methanolic extract	3β-(4-hydroxy cinnamoyl)-12-ursen-28-oic acid and 3β-hydroxy-12-ursen-28-oic acid / pentacyclic triterpenoid	α-glucosidase inhibitors that hydrolyzes oligosaccarides into monosaccarides thus reduce the postprandial glycemic excursions and decrease postprandial hypoglycaemia	(Choudhary, 2001) (Gami et al., 2012)
Anti-inflammatory	*M. elengi L.*	Leaf Chloroform extract : 1-Spinasterol 2-ursolic acid 3-3β, 6β, 19α, 23-tetrahydroxyurs-12-en-28-oic acid Bark Chloroform extract: 4- taraxerol 5- spinasterol β-Dglucopyranoside	1-Spinasterol 2-ursolic acid 3-3β, 6β, 19α, 23-tetrahydroxyurs-12-en-28-oic acid 4- taraxerol 5- spinasterol β-Dglucopyranoside	Strong inhibitory effects against prostaglandin biosynthesis as following: - Spinasterol: against COX-1 and COX-2. -Ursolic acid and 3β, 6β, 19α, 23-tetrahydroxyurs-12-en-28-oic acid showed selective COX-2 inhibition. -3β, 6β, 19α, 23-tetrahydroxyurs-12-en-28-oic acid showed slightly higher inhibition.	(Amir et al., 2013)

				-Taraxerol showed moderate selective COX-1 inhibitory activity. -Spinasterol β-Dglucopyranoside indicated the strongest selective COX-1 inhibitory activity,	
Antioxidant	*M. caffra E.Mey. ex A.DC.*	Leaves / Dichloromethane (DCM) extract.	Ursolic acid acetate/ pentacyclic tritepenoids	-The most potent of scavenging ABTS* radicals, and generally more active in scavenging DPPH and ABTS* radicals (≥ 60%) and poor scavengers of biological radicals, OH* and NO* (≤ 40%). - Metal chelating activity (60±0.04%) higher than that of citric acid (55±0.23%).	(M. B. C. Simelane, 2014)
Anti-convulsion	*M. elengi L.*	Bark / methanolic, aqueous, and n-butanolic extract respectively.	_____	Increase the latency time and survival time may suggest the presence of compounds potentiating GABAergic action.	(Ganu et al., 2011)
Hepatoprotective	*M. elengi L.*	Leaf/ ethanolic extract	β-sitosterol	Decreases hepatic marker enzyme ALT, AST, ALP and GGT	(Jaffar, Khasim, & Prasad, 2020)
Antiurolithiatic activity.	*M. elengi L.*	Bark / alcoholic extract	Lupeol / triterpenes	-Prevent the lipid peroxidation-induced renal damage caused by calcium oxalate crystal deposition in the kidney. -Significant decrease in MDA and increased GSH, SOD, and CAT.	(Ashok, Koti, & Vishwanathswamy, 2010)

Anticancer / cytotoxicity	*M. laurifolia (Forssk.) Friis* .	Leaves/ *n*-hexane fraction of ethanolic extract	Alpha-amyrin / Triterpenoid	Showed promising cytotoxicity against human liver cancer cell line (HEPG2) .	(Hifnawy et al., 2012)
Antihyperlipidemic	*M. laurifolia (Forssk.) Friis*	Leaves/ butanolic extract	Triterpenes and saponins	Reduces levels of total cholesterol, triglyceride, LDL cholesterol and lipase activity (Lip. A) but increasing HDL levels.	(HA, Mahfouz, Elharrif, & Allah, 2019)
Antipyretic	*M. caffra E.Mey. ex A.DC.*	Leaves / Dichloromethane (DCM) extract.	Ursolic acid acetate / pentacyclic tritepenoids	Showed significant activity against yeast induced feverhowever	(M. B. C. Simelane, 2014)
Anti-plasmodial against the plasmodium parasites	*M. caffra E.Mey. ex A.DC.*	Leaves/ Methanol (MeOH), Dichloromethane (DCM) extract..	Ursolic acid and ursolic acid acetate /pentacyclic tritepenoids	-MeOH extract showing IC_{50} 11.4 (µg/ml) - DCM extract showing IC_{50} 2.14 (µg/ml)	(M. B. C. Simelane, 2014)
	M. obtusifolia Lam.	Bark/ Ethyl acetate (EtAc), Dichloromethane (DCM) extract.	Taraxerol and Sawamilletin / pentacyclic tritepenoids	- Ethyl acetate extract showing IC_{50} 32.5 (µg/ml) - DCM extract showing IC_{50} 8.08 (µg/ml)	

Conclusion:

The genus *Mimusops* showed the existence of a broad range of triterpenoids and their glycosides. This review study covered the triterpenoid saponins and sterols chemical constituents and biological activities studies reported in *Mimusops* genus. In regard to biological activities of these triterpenoid saponins chemical constituents, the genus *Mimusops* has received increasing attention all over the world. Modern pharmacological studies have suggested that triterpenoid saponins constituents have a number of diverse and complex biological activities, including anti-inflammatory, antiulcer activity, antibacterial activity, cytotoxic, anti-hypercholesterolemic, antioxidant, and hypoglycemic activities. Amongst these broad-ranging properties, anti-hypercholesterolemic should be paid more attention.

This review expounds the chemical ingredients and its bioactivities of *Mimusops* genus, which may not only contribute to the scientific understanding of the traditional application, but also benefit the new drug research and product development of *Mimusops* genus.

References:

Akhtar, N., Ali, M., & Alam, M. (2010). New steroidal glycosides from the stem bark of Mimusops elengi. *Chemistry of natural compounds*, *46*, 549-553.

Akhtar, N., Ali, M., & Alam, M. S. (2009). Pentacyclic triterpenes from the stem bark of Mimusops elengi L. *Acta Poloniae Pharmaceutical and Drug Research*, *66*(5), 549-552.

Amir, F., Wong, K. C., Eldeen, I., Asmawi, M. Z., & Osman, H. (2013). Evaluation of biological activities of extracts and chemical constituents of Mimusops elengi. *Tropical Journal of Pharmaceutical Research*, *12*(4), 591-596.

Ashok, P., Koti, B. C., & Vishwanathswamy, A. (2010). Antiurolithiatic and antioxidant activity of Mimusops elengi on ethylene glycol-induced urolithiasis in rats. *Indian journal of pharmacology*, *42*(6), 380.

Choudhary, M. I. (2001). Bioactive natural products as a potential source of new pharmacophores. A theory of memory. *Pure and Applied Chemistry*, *73*(3), 555-560.

Eskander, J., Lavaud, C., Abdel-Khalik, S. M., Soliman, H. S., Mahmoud, I. I., & Long, C. (2005). Saponins from the Leaves of Mimusops l aurifolia. *Journal of Natural Products*, *68*(6), 832-841.

Eskander, J., Lavaud, C., Pouny, I., Soliman, H. S., Abdel-Khalik, S., & Mahmoud, I. (2006). Saponins from the seeds of Mimusops laurifolia. *Phytochemistry*, *67*(16), 1793-1799.

Gami, B., Pathak, S., & Parabia, M. (2012). Ethnobotanical, phytochemical and pharmacological review of Mimusops elengi Linn. *Asian Pacific Journal of Tropical Biomedicine*, *2*(9), 743-748.

Ganu, G., Garud, A., Agarwal, V., Talele, S., Jadhav, S., & Kshirsagar, A. (2011). Anticonvulsant activity of a Mimusops elengi in experimental animals. *J Pharm Res*, *4*(9), 2938-2940.

HA, A. M., Mahfouz, M. K., Elharrif, M. G., & Allah, A. H. F. (2019). ANTIHYPERLIPIDEMIC EFFECT OF MIMUSOPS LARIFOLIA BUTANOLIC EXTRACT ON HIGH-FAT DIET-INDUCED OBESE RAT.

Hifnawy, M., Sokkar, N., Ezzat, S. M., Raslan, M., Y Salib, J., & Sleem, A. (2012). Cytotoxicity and suppressive effect of leaves of mimusops laurifolia on carbon tetrachloride-induced liver injury in rats and its bioactive constituents.

Jaffar, S., Khasim, S., & Prasad, M. (2020). Protective Effect of Mimusops elengi L. on Renal and Hepatic Markers in STZ-Induced Diabetic Rats. *Medicinal Plants: Biodiversity, Sustainable Utilization and Conservation*, 509-520.

Jahan, N., Ahmed, W., & Malik, A. (1995a). A lupene-type triterpene from Mimusops elengi. *Phytochemistry*, *39*(1), 255-257.

Jahan, N., Ahmed, W., & Malik, A. (1995b). New steroidal glycosides from Mimusops elengi. *Journal of Natural Products*, *58*(8), 1244-1247.

Kadam, P. V., Yadav, K. N., Deoda, R. S., Shivatare, R. S., & Patil, M. J. (2012). Mimusops elengi: A

review on ethnobotany, phytochemical and pharmacological profile. *Journal of Pharmacognosy and Phytochemistry*, *1*(3), 64-74.

Lavaud, C., Massiot, G., Becchi, M., Misra, G., & Nigam, S. (1996). Saponins from three species of Mimusops. *Phytochemistry*, *41*(3), 887-893.

Lim, T., & Lim, T. (2013). Mimusops elengi. *Edible Medicinal And Non-Medicinal Plants: Volume 6, Fruits*, 119-128.

Misra, G., & Mitra, C. (1968). Mimusops hexandra—III. Constituents of root, leaves and mesocarp. *Phytochemistry*, *7*(12), 2173-2176.

Misra, G., & Mitra, C. (1969). Mimusops manilkara, constituents of fruit and seed. *Phytochemistry*, *8*(1), 249-252.

Misra, G., Nigam, S., & Mitra, C. (1974). Studies on Mimusops Spp. *Planta medica*, *26*(06), 155-165.

Rajkumara, S., Pandiselvi, A., & Sandhiya, G. (2012). Isolation of Chemical Constituents from Mimusops elengi bark and Evaluation of Anti-inflammatory activity. *Int J Phytopharm Res*, *3*(1), 9-15.

Rani, S., & Rahman, K. (2017). Molsari (Mimusops elengi Linn.): A boon drug of traditional medicine. *International Journal of Pharmaceutical Sciences Research*, *8*(1), 17.

Roqaiya, M., Begum, W., Majeedi, S. F., & Saiyed, A. (2015). A review on traditional uses and phytochemical properties of Mimusops elengi Linn. *IJHM*, *2*(6), 20-23.

Sahu, N. (1996). Triterpenoid saponins of Mimusops elengi. *Phytochemistry*, *41*(3), 883-886.

Sahu, N., Mandal, N., Banerjee, S., & Siddiqui, K.

(2001). Chemistry and biology of the triterpenes and saponins from seeds of Mimusops elengi. *Journal of herbs, spices & medicinal plants, 8*(4), 29-37.

Sahu, N. P., Koike, K., Jia, Z., & Nikaido, T. (1997). Triterpenoid saponins from Mimusops elengi. *Phytochemistry, 44*(6), 1145-1149.

Sen, S., Sahu, N. P., & Mahato, S. B. (1995). Pentacyclic triterpenoids from Mimusops elengi. *Phytochemistry, 38*(1), 205-207.

Simelane, M. B., Shonhai, A., Shode, F. O., Smith, P., Singh, M., & Opoku, A. R. (2013). Anti-plasmodial activity of some Zulu medicinal plants and of some triterpenes isolated from them. *Molecules, 18*(10), 12313-12323.

Simelane, M. B. C. (2014). *Antimalarial activity of hypoxis colchicifolia, bak, mimusops caffra, E. Mey. ex A. DC and mimusops obtusifolia, lam from South Africa*. University of Zululand.

Singh, K. L., Singh, D., & Singh, V. K. (2012). Characterization of the molluscicidal activity of Bauhinia variegata and Mimusops elengi plant extracts against the fasciola vector Lymnaea acuminata. *Revista do Instituto de Medicina Tropical de São Paulo, 54*, 135-140.

Srivastava, M., & Singh, J. (1994). A new triterpenoid saponin from Mimusops hexandra. *International journal of pharmacognosy, 32*(2), 197-200.

Suedee, A. (2012). *Phytochemical studies of mimusops elengi and Pometia pinnata leaf extracts with anti-HIV-1 integrase activity.* Prince of Songkla University.