1 INTRODUCTION

1.1 Introduction

Mangifera is in the family Anacardiaceae. The genus *Mangifera* contains about 70 species. Twenty species have been found in Thailand, they are shown as follow: (Wichan, *et al*., 2000).

M. caloneura, Kurz.	*M. lagenifera*, Griff.
M. caesia, Jack.	*M. laurina*, Griff.
M. cochinchinesis, Griff.	*M. longipetiolata*, Griff.
M. collina, Griff.	*M. linearifolia*, Hook.
M. flava, Roxb.	*M. macrocarpa*, Hook.
M. foetida, Lour.	*M. oblongifolia*, Hook.
M. gedebe, Linn.	*M. odorata*, Griff.
M. gracilipes, Hook.	*M. pentandra*, Hook.
M. griffithii, Hook.	*M. quadrifida*, Jack.
M. indica, Linn.	*M. sylvatica*, Roxb

Mangifera odorata Griff. is known as Mamuang pa มะม่วงป่า, Kinning (Narathiwat) กินนิง, Mamuang ching rit มะม่วงจิ้งหรีด (Smitinand, 2001). It is a large-size tree about 100 feet high. Leaves are coriaceous, oblong or elliptic-lanceolate acute and acuminate, reticulate on both sides, base cuneat; nerves prominet 20 pairs, 6 to 9 inches long, 2 to 4 inches wide; petioles 1.25 to 1.75 inches long. Panicles are 8 inches long with branches sepals 5 cm., ovate-oblong, red. Petals are 5, 3 cm. times as long, oblong, yellow edged rose, ridge 3 cm. confluent, yellow. Stemens are 2 cm. nearly as long, white anthers black; staminodes short, white tipped rose. Fruits are oblong, yellowish green with yellow flesh (Hooker, 1879).

Figure 1 *Mangifera odorata* Griff.

1.2 Literature review

1.2.1 Chemical constituents from *Mangifera* species

According to the informations from NAPRALERT database, Science direct, Chemical Abstracts, Med plant database and Dictionary of Natural products, benzenoids, coumarins, flavonoids, flavonols, monoterpenes, sesquiterpenes, triterpenes, steroids, and xanthones were chemical constituents found in *Mangifera* genus (**Table 1**).

Table 1 Compounds isolated from *Mangifera* species

a: Benzenoids	b: Coumarins	c: Flavonoids
d: Flavonols	e: Monoterpenes	f: Sesquiterpenes
g: Steroids	h: Triterpenes	i: Xanthones

Scientific name	Compound	Reference
M. indica		
Barks	Amentoflavone **1c**	Khan, *et al*., 1992
	Mangiferin **2i**	Nott, *et al*., 1967
		Pharm, *et al*., 1991
Flowers	4-Phenyl-*n*-butyl gallate **1a**	Khan, *et al*., 1989
	6-Phenyl-*n*-hexyl gallate **2a**	
	n-Octyl gallate **4a**	
	n-Pentyl gallate **3a**	
	n-Propyl gallate **5a**	
Fruits	β-Myrcene **8e**	Bandyopadhyay, *et al.*, 1983
	β-Sitosterol **1g**	Cojocaru, *et al*., 1986
	cis-Ocimene **10e**	Gholap, *et al*., 1977
	Catechin **2c**	Joel, *et al*., 1978

Table 1 (continued)

Scientific name	Compound	Reference
	Caryophyllene **3f** Paeonidin-3-galactoside **4c**	Macleod, *et al*., 1982
Fruits Peel	3β,20-Diol-taraxastane **36h** 3-Oxo-taraxastane-20(*R* or *S*)-ol **35h** β-Sitosterol **1g** Mangiferin **2i** Paeonidin-3-galactoside **4c**	Cojocaru, *et al*., 1986 Tanaka, *et al*., 1984
Fruits Pulp	α-Pinene **11e** γ-Terpinene **17e** Valenecene **8f** Caryophyllene **3f** *p*-Cymene **5e** α-Humulene **7f** Ocimene **9e** α-Phelladrene **14e** β–Phelladrene **13e**	Craveiro, *et al*., 1980 Macleod, *et al*., 1982
Kernels	β-Amyrin **2h** α-Amyrin **1h** Canophyllol **11h** Cycloartenone **5h** Friedelin **8h** Lophenol **6h** Lupeol **7h** 3-Oxo-25(*R*)-24-methylene-cycloartan-26-ol **20h** Paeonidin-3-galactoside **4c**	Gaydou, *et al*., 1984

Table 1 (continued)

Scientific name	Compound	Reference
	Stigmast-7-en-3β-ol **2g** Stigmasterol **3g** β-Sitosterol **1g**	
Latex (stem)	α-Amyrin **2h** β-Amyrin **1h** Canophyllol **11h** Cycloartenone **5h** 23(*R*)-Hydroxy-cycloart-24-en-26-oic acid **18h** 23(*R* or *S*)-Hydroxy-3-oxo-cyclo-art-24-en-26-oic acid **17h** Lupeol **7h** β-Sitosterol **1g** Stigmasterol **3g**	Bandyopdadhyay, *et al*., 1985
Leaves	Lupeol **7h** β-Sitosterol **1g** Taraxerol **38h** Aromadendrene **1f** β-Bulnesene **5f** δ-Cadinene **2f** Camphene **1e** Cycloartenone **11h** Euxanthone **1i** β-Pinene **12e** α-Terpinolene **15e** α-Amirone **42h** β-Amirone **41h** Friedelin **8h**	Anjaneyulu, *et al*., 1982 Craveiro, *et al*., 1980 Gaydo, *et al*., 1984

Table 1 (continued)

Scientific name	Compound	Reference
	Lophenol **6h**	Griffith, *et al*., 1959
	β-Caryophyllene **3f**	Hu, *et al*., 1994
	Gallic acid **6a**	Lu, *et al*., 1982
	Glochidonol **43h**	
	β-Pinene **12e**	
	Car-3-ene **3e**	Nigam, 1962
	Indicoside A **39h**	
	Indicoside B **40h**	
	Mangiferonic acid **34h**	
	Mangiferin **2i**	
	Sabinene **19e**	
	α-Thujene **18e**	
	Mangiferin-6′-*O*-gallate **5i**	Pharm, *et al*., 1982
	β-Ocimene **9e**	
	α-Pinene **11e**	
	Euxanthone **1i**	Proctor, *et al*., 1969
	Quercetin **6d**	
	Catechin-3-*O*-gallate **3c**	Tanaka, *et al*., 1984
	α-Copaene **4f**	Craveiro, *et al*., 1980
	Friedelin **8h**	
	Gallic acid **6a**	
	Humulene **7f**	
	Linalool **7e**	
	Rutin **7d**	
	Sabinene **19e**	
	Taraxerone **14h**	
	γ-Terpinene **17e**	

Table 1 (continued)

Scientific name	Compound	Reference
Panicles	δ-Camphene **14e** β-Bulnesene **5f** Cadinene **2f** Gallic acid **3b** Manghopanal **37h** Mangiferin **2i** Ellagic acid **3b** Lupeol **7h** β-Sitosterol **1g**	Craveiro, *et al*., 1980 Maheswari, *et al*., 1975
Roots	β-Sitosterol **1g** 3-Hydroxy-2-(4′-methyl-benzoyl) chromone **1b** 3-Methoxy-2-(4′-methyl-benzoyl) chromone **2b** Cycloartanol **4h**	Khan, *et al*., 1994
Root Barks	α-Amyrin **2h** Mangiferolic acid **53h** Mangiferonic acid **34h** β-Sitosterol **1g** Mangiferin **2i** Manghopanal **37h** 23(*S*)-Hydroxy-cycloart-24-en-26-oic acid **19h**	Anjaneyulu, *et al*., 1982 Gupta, *et al*., 1999
Seeds	3-Oxo-25(*R*)-24-methylene-cyclo-artan-26-ol **20h** 3-Oxo-25(*R*)-24-methylene-cyclo-artane **21h**	Kolhe, *et al*., 1982

Table 1 (continued)

Scientific name	Compound	Reference
Shoots	Amentoflavone **1c** Friedelan-3β-ol **9h** Kaempferol **5d** Lupenone **6h** Lupeol **7h** 3-*O*-Methyl ether myricetin **3d** Methyl ether quercetin **4d** Isoquercetin **2d** 1,3,5,6,7-Pentamethoxyxanthone **3i** 1,3,6,7,8-Pentahydroxyxanthone **4i**	Ghosal, *et al*., 1978
Stem Barks	α-Amyrin **2h** 24-Methylene cycloartanol **49h** Cycloartenone **5h** Friedelan-3β-ol **9h** Friedelin **8h** 6β-Hydroxy-stigmast-4-en-3-one **7g** 3β,24(*R*),25-Triolcycloartane **45h** β-Amyrin **2h** Cycloartenol **4h** Canophyllol **11h** 23(*R*)-Hydroxy-cycloart-24-en-26-oic acid **18h** Daucosterol **4g** Ambonic acid **23h** 3β,26-Diol-cycloart-24-ene **58h** 3β,24(*R*)-Diol-cycloart-25-ene **25h** 3β,20(*S*)-Diol-dammar-24-ene **50h**	Anjaneyulu, *et al*., 1999 Khan, *et al*., 1994 Anjaneyulu, *et al*., 1999; 1993; 1989; 1985 Anjaneyulu, *et al*., 1995 Anjaneyulu, *et al*., 1994

Table 1 (continued)

Scientific name	Compound	Reference
	3β,24-Diol-24-methylenecyclo artane **48h** Friedelan-3β-ol **9h** Hydroxymangiferolic acid **52h** β-Sitosterol **1g** Ambolic acid **24h** Cycloart-23-en-*3*β,25-diol **54h** 3β-Hydroxy-cycloart-24-en-26-al **55h** 23-(*R* or *S*)-Hydroxy-3-oxo-cycloart-24-en-26-oic acid **44h** 3β,23-(*R*)-Hydroxy-cycloart-24-en-26-oic acid **56h** 3β,23-(*S*)-Hydroxy-cycloart-24-en-26-oic acid **57h** 3α,22-Dihydroxy-cycloart-trans-24-en-26-oic acid **29h** 3α,27-Dihydroxy-cycloart-trans-24-en-26-oic acid **30h** 3β,22-Dihydroxy-cycloart-trans-24-en-26-oic acid **31h** 3β,23-dihydroxy-cycloart-trans-24-en-26-oic acid **32h** 3β,24,27-Triol-24-epi-cycloart-25-ene **28h** 3β,24,25-Triol-cycloartane **47h** 3β,24(*S*)-Diol-cycloart-25-ene **26h**	Anjaneyulu, *et al*., 1989 Anjaneyulu, *et al*.,

Table 1 (continued)

Scientific name	Compound	Reference
	3β,24,27-Triol-cycloart-25-ene **27h** 3β,24(*S*),25-Triol-cycloartane **46h** 3β,24,25-Triol-cycloartane **47h** 20(*S*),26-Diol-3-keto-dammarane-trans-24-ene **51h** Cycloart-23-en-*3*β,25-diol **54h** Indicoside A **39h**	1985 Khan, *et al*., 1993
M. indica* *cv. chausa Stem barks	Friedelin **8h** Mangopanal **37h** Mangiferin **2i** Mangiferonic acid **34h** Mangoleanone **33h** Taraxerol **38h** 3β,24,27-Triol-24-epi-cycloart-25-ene **28h**	Sharma, *et al*., 1994
M. indica* *cv. chittoor Part not specified	Cycloartenol **4h** Cycloartenone **5h** 3β,24(*R*)-Diol-cycloart-25-ene **25h** 3β,24(*S*)-Diol-cycloart-25-ene **26h** 3β,26-Diol-24-methylene-cycloart-ane **43h** 6β-Hydroxy-stigmast-4,22-diene-3-one **8g**	Anjaneyulu, *et al*., 1992

Table 1 (continued)

Scientific name	Compound	Reference
	6β-Hydroxy-stigmast-4-en-3-one **7g** Mangiferonic acid **34h** Manglupenone **33h** Progesterone **6g** β-Sitosterol **1g**	
M. indica ***cv. desi*** Stem barks	Mangdesisterol **9g** 3β,26-Diol-24-methylene-cycloart-ane **22h** Mangfarnesolic acid **34h** Taraxerol **38h**	Sharma, *et al*., 1995
	3α,27-Dihydroxy-cycloart-trans-24-en-26-oic acid **30h** 3β,22-Dihydroxy-cycloart-trans-24-en-26-oic acid **31h**	Sharma, *et al*., 1992
M. indica ***cv. dusehri*** Stem barks	Mangcoumarin **5b** Methyl mangiferolic acid **13h** Manglupenone **33h** Mangdessisterol **9g** 3α-Taraxastane **16h** Friedelan-3β-ol **9h** Friedelan-3α-ol **10h** Friedelin **8h**	Sharma, *et al*., 1993

Table 1 (continued)

Scientific name	Compound	Reference
	Mangiferolic acid **53h** Hydroxy mangiferolic acid **52h** Mangiferonic acid **34h** β-Sitosterol **1g** 6β-Hydroxy-stigmast-4-en-3-one **7g** 3β-6α-Diol-5α-stigmastane **36h**	
M. indica ***cv. keitt*** Fruits	Car-3-ene **3e** *p*-Cymene **5e** β-Myrcene **8e** α-Phelladrene **13e** β-Phelladrene **14e** α-Pinene **11e** α-Terpinolene **15e**	Mac leod, *et al*., 1985
M. indica ***cv. kensington*** Fruits	γ-Cadinene **2f** Camphene **1e** Car-2-ene **2e** Car-3-ene **3e** β-Caryophyllene **3f** α-Copaene **4f** *p*-Cymene **5e** *p*-Geranial **6e**	Hermano, *et al*., 1934

Table 1 (continued)

Scientific name	Compound	Reference
	α-Humulene **7f** Linalool **7e** β-Myrcene **8e** *cis*-Ocimene **10e** β-Phelladrene **13e** Sabinene **19e** α-Terpinene **16e** γ-Terpinene **17e** α-Terpinolene **15e** α-Thujene **18e**	
M. indica cv. tommyat-kins Fruits	Car-2-ene **2e** Car-3-ene **3e** β-Caryophyllene **3f** α-Copaene **4f** *p*-Cymene **5e** α-Humulene **7f** Linalool **7e** β-Myrcene **8e** α-Phellandrene **13e** α-Pinene **11e** β-Pinene **12e** α-Terpinolene **15e**	Hermano, *et al*., 1934

Table 1 (continued)

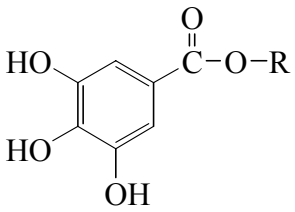
Scientific name	Compound	Reference
M. indica l/fusarium moniliforme Florets	Gallic acid **6a** Mangiferin **2i** Pregnenolone **5g** Progesterone **6g** 1,3,6,7-Tetrahydroxyxanthone **4i**	Anjaneyulu, *et al*., 1994
M. indica Varieties Leaves, seed and twigs	Amentoflavone **1c** Ellagic acid **3b** Fisetin **1d** Gallic acid **6a** *p*-Geranial **6e** Mangiferin **2i** Quercetin **6d** Trifolin **8d**	Anjaneyulu, *et al*., 1998
M. persiciformis Leaves	Friedelin **8h** Mangiferin **2i** Quercetin **6d** β-Sitosterol **1g** Taraxerol **38h**	Khan, *et al*., 1993
M. sylvatica Stem barks	Cycloartenol **4h** Friedelan-3β-ol **9h**	Anjaneyulu, *et al.,* 1994

Table 1 (continued)

Scientific name	Compound	Reference
	Friedelin **8h** Olean-12-en-3β,11α-diol **3h** β-Sitosterol **1g**	

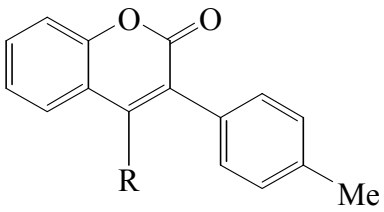
Structures of compounds from Mangifera species

a. Benzenoids

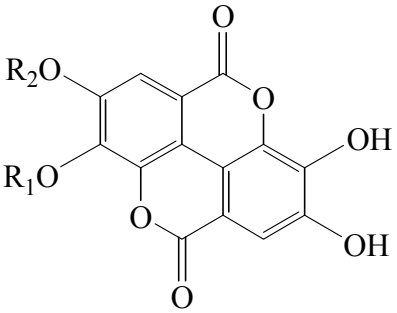


1a : R = 4-phenyl-*n*-buty : 4-Phenyl-*n*-butyl gallate
2a : R = 6-phenyl-*n*-hexyl : 6-Phenyl-*n*-hexyl gallate
3a : R = *n*-pentyl : *n*-Pentyl gallate
4a : R = *n*-octyl : *n*-Octyl gallate
5a : R = *n*-propyl : *n*-Propyl gallate
6a : R = H : Gallic acid

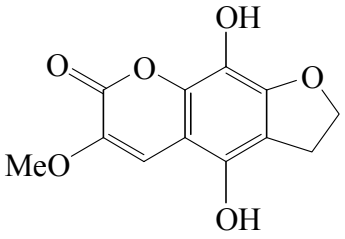
b. Coumarins



1b : R = OH : 3-Hydroxy-2-(4'-methyl-benzoyl) chromone
2b : R = OMe : 3-Methoxy-2-(4'-methyl-benzoyl) chromone

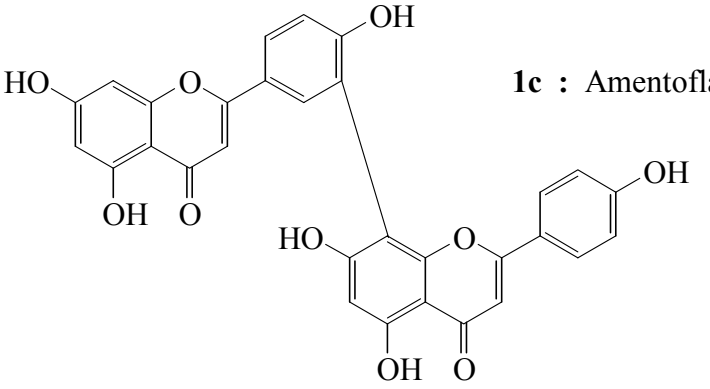


3b : R_1, R_2 = H: Ellagic acid
4b : R_1, R_2 = CH_3: 3,4,Di-*O*-methyl ellagic acid

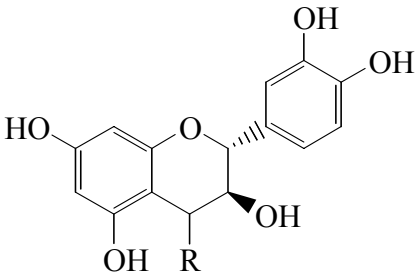


5b : Mangcoumarin

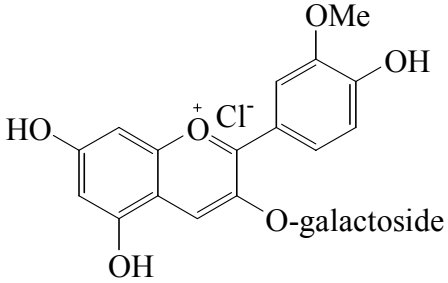
c. Flavonoids



1c : Amentoflavone

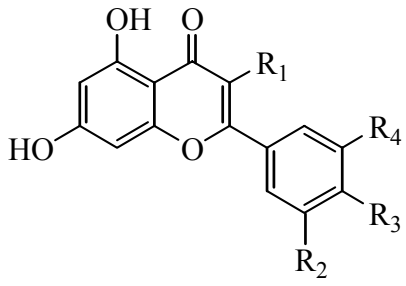


2c : R = H : Catechin
3c : R = *O*-gallate : Catechin-3-*O*-gallate

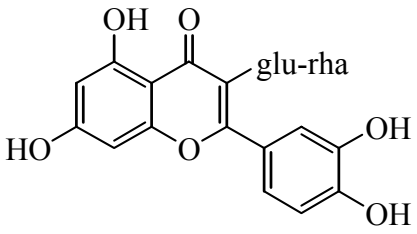


4c : Paeonnidin-3-galactoside

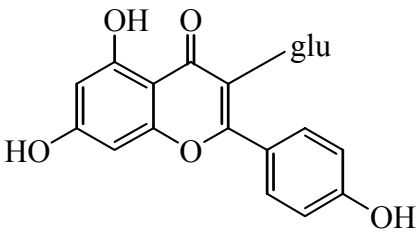
d. Flavonols



1d : R_1 = OH, R_2 = H, R_3 = OH, R_4 = OH : Fisetin
2d : R_1 = *O*-Glucosyl, R_2 = H, R_3 = OH, R_4 = OH : Isoquercitin
3d : R_1 = OMe, R_2 = OH, R_3 = OH, R_4 = *O*-Glucosyl : 3-*O*-Methyl ether myricetin
4d : R_1 = OMe, R_2 = H, R_3 = OH, R_4 = OH : Methyl ether quercetin
5d : R_1 = OH, R_2 = H, R_3 = OH, R_4 = H : Kaempferol
6d : R_1 = OH, R_2 = OH, R_3 = OH, R_4 = H : Quercetin

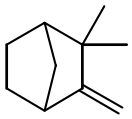


7d : Rutin

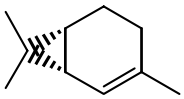


8d : Trifolin

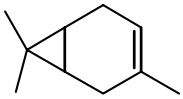
e. Monoterpenes



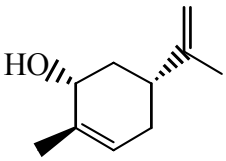
1e: Camphene



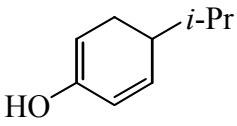
2e: Car-2-ene



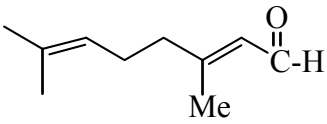
3e: Car-3-ene



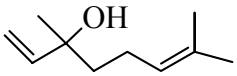
4e: Carveol



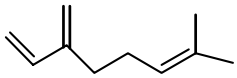
5e: *p*-Cymene



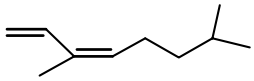
6e: *p*-Geranial



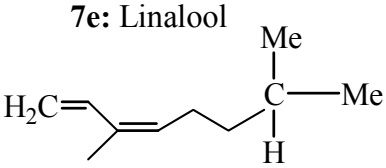
7e: Linalool



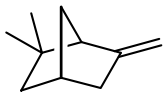
8e: β-Myrcene



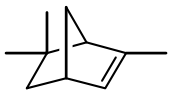
9e: β-Ocimene



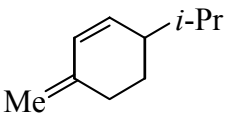
10e: *cis*-Ocimene



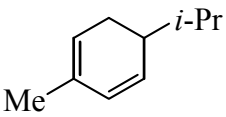
11e: α-Pinene



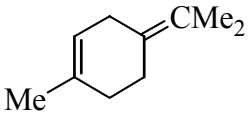
12e: β-Pinene



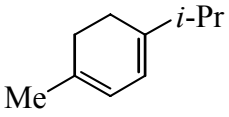
13e: β-Phelladrene



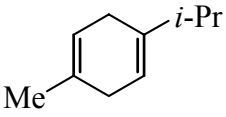
14e: α-Phelladrene



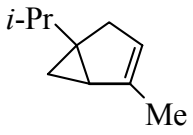
15e: α-Terpinolene



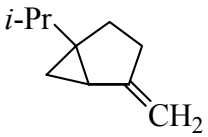
16e: α-Terpinene



17e: γ-Terpinene

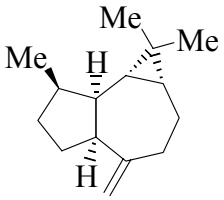


18e: α-Thujene

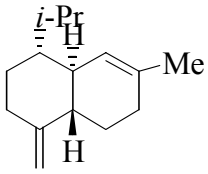


19e: Sabinene

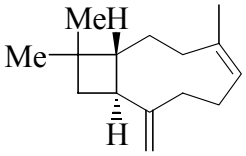
f. Sesquiterpenes



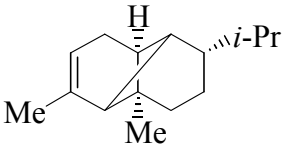
1f : Aromadendrene



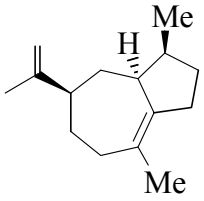
2f : δ-Cadinene



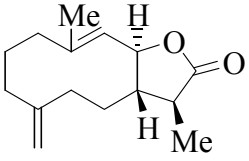
3f : β-Caryophyllene



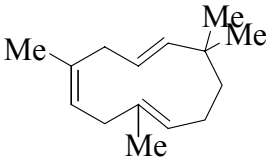
4f : α-Copaene



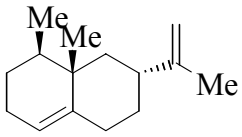
5f : β-Bulnesene



6f : α-Gallicin

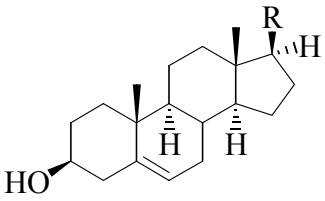


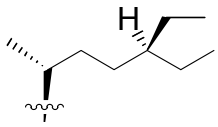
7f : α-Humulene



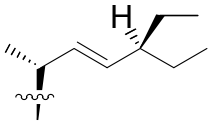
8f : Valenecene

g. Steriods

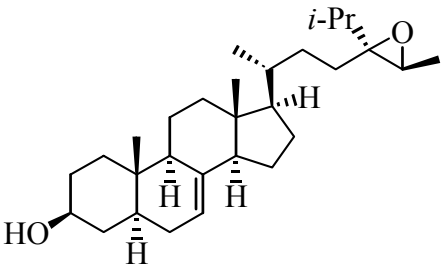


1g : R = 

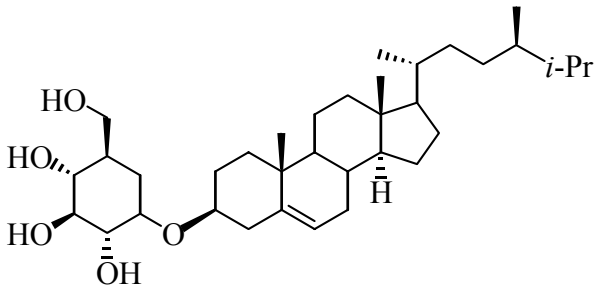
: β-Sitosterol

3g : R = 

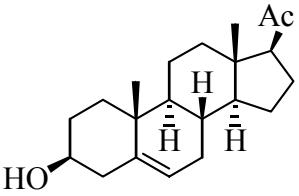
: Stigmasterol



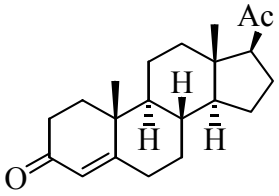
2g : Stigmast-7-en-3β-ol



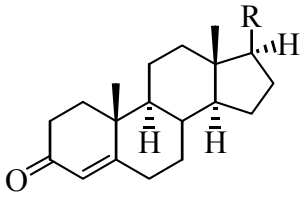
4g : Daucosterol

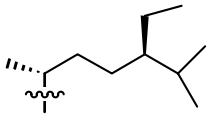


5g : Pregnenolone

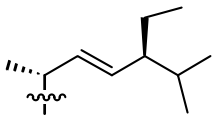


6g : Progesterone

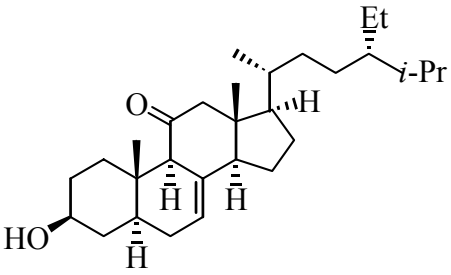


7g : R = 

6β-Hydroxy-stigmat-4-en-3-one

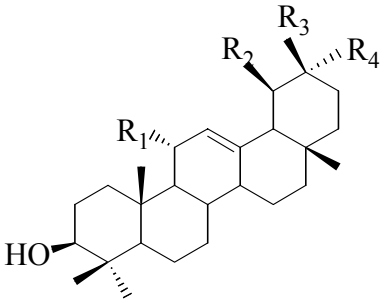
8g : R = 

6β-Hydroxy-stigmat-4,22-dien-3-one

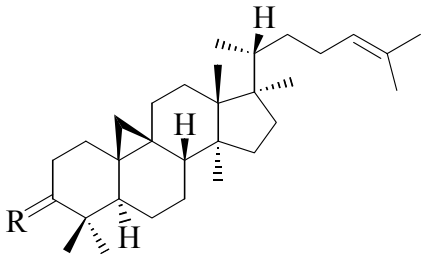


9g : Mangdessisterol

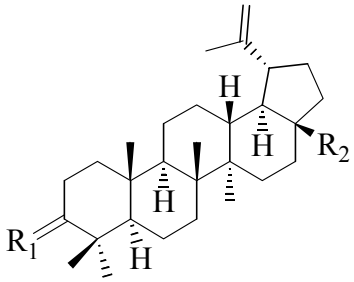
h. Triterpenes



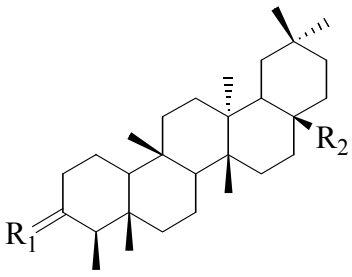
1h : R_1= H, R_2 = H, R_3 = Me, R_4 = Me : β-Amyrin
2h : R_1= H; R_2 = H; R_3 = H; R_4 = Me : α-Amyrin
3h : R_1= OH, R_2 = H, R_3 = Me, R_4 = Me : Olean-12-en-3β,11α-diol



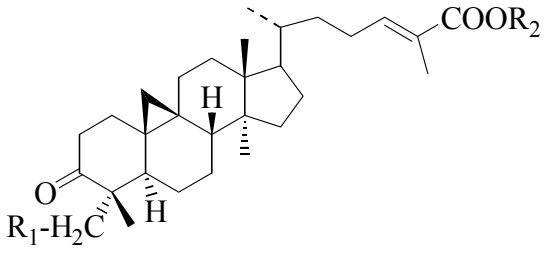
4h : R = α-H, β-OH : Cycloartenol
5h : R = O : Cycloartenone



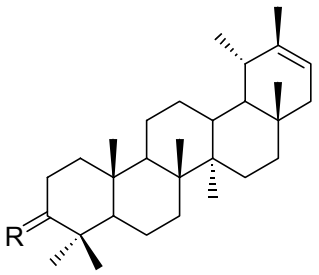
6h : R_1 = O, R_2 = Me : Lupenone
7h : R_1 = α-H β-OH, R_2 = Me : Lupeol



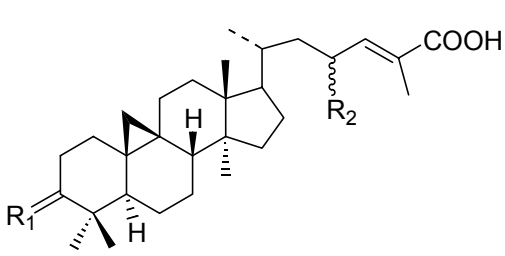
8h : R_1= O, R_2 = Me : Fridelin
9h : R_1= α-H β-OH, R_2 = Me : Friedelan-3β-ol
10h : R_1= β-H, α-OH, R_2 = Me : Friedelan-3α-ol
11h : R_1= O, R_2 = CH_2OH Canophyllol



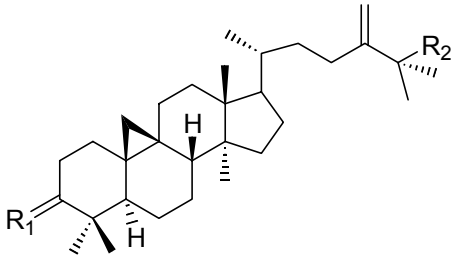
12h : R_1 = OH, R_2 = H : 3-Oxo-29-hydroxy-24-*E*-en-26-oic acid
13h : R_1 = H, R_2 = Me : Methyl ester mangiferolic acid
53h : R_1 = H, R_2 = H : Mangiferolic acid



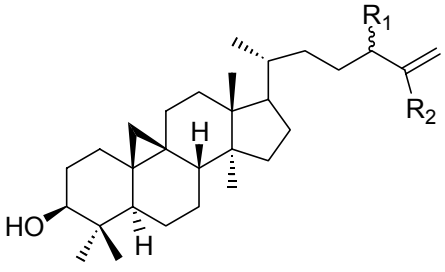
14h: R = O: Taraxerone
15h: R = α-H, β-OH: β-Taraxastane
16h: R = β-H, α-OH: α-Taraxastane



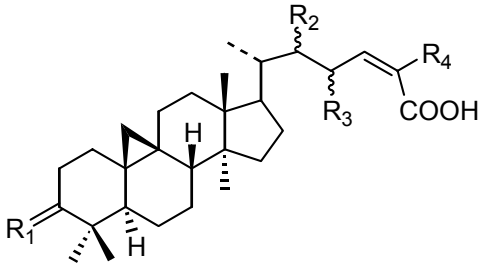
17h: R_1 = O; R_2 = OH (*R* or *S*): 23(*R* or *S*)-Hydroxy-3-oxo-cycloart-24-en-26-oic acid
18h: R_1 = α-H, β-OH; R_2 = OH (*R*): 23(*R*)-Hydroxy-cycloart-24-en-26-oic acid
19h: R_1 = β-H, α-OH; R_2 = OH (*S*): 23(*S*)-Hydroxy-cycloart-24-en-26-oic acid



20h: R_1 = O; R_2 = CH_2OH: 3-Oxo-25(*R*)-24-methylene-cycloartan-26-ol
21h: R_1 = O; R_2 = CH_3: 3-Oxo-25(*R*)-24-methylene-cycloartane
22h: R_1 = α-H, β-OH: R_2 = CH_2OH 3β,26-Diol-24-methylene-cycloartane
23h: R_1 = O; R_2 = CO_2H: Ambonic acid
24h: R_1 = α-H, β-OH, R_2 = CO_2H : Ambolic acid



25h: R_1 = OH; R_2 = Me : 3β,24(*R*)-Diol-cycloart-25-ene
26h: R_1 = OH; R_2 = Me : 3β,24(*S*)-Diol-cycloart-25-ene
27h: R_1, R_2 = OH : 3β,24,27-Triol-cycloart-25-ene
28h: R_1, R_2 = OH : 3β,24,27-Triol-24-epi-cycloart-25-ene

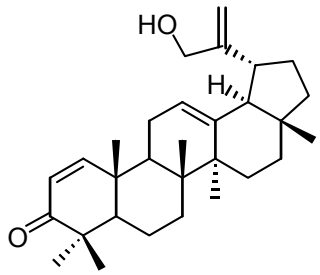


29h: R_1 = β-H, α-OH; R_2 = OH; R_3 = H; R_4 = Me: 3α,22-Dihydroxy-cycloart-trans-24-en-26-oic acid

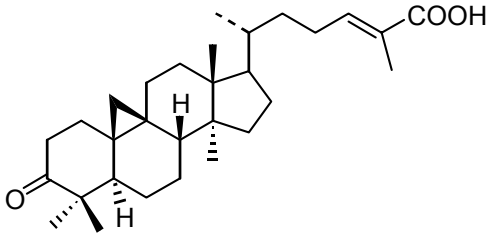
30h: R_1 = α-H, β-OH; R_2 = H; R_3 = H; R_4 = H: 3α,27-Dihydroxy-cycloart-trans-24-en-26-oic acid

31h: R_1 = α-H, β-OH; R_2 = OH; R_3 = H; R_4 = Me: 3β,22-Dihydroxy- cycloart-trans-24-en-26-oic acid

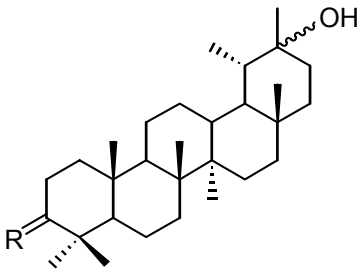
32h: R_1 = α-H, β-OH; R_2 = H; R_3 = OH; R_4 = Me: 3β,23-Dihydroxy-cycloart-trans-24-en-26-oic acid



33h: Manglupenone

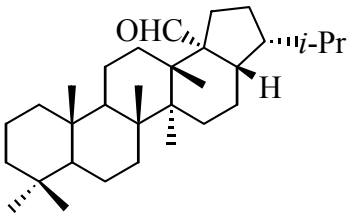


34h: Mangiferonic acid

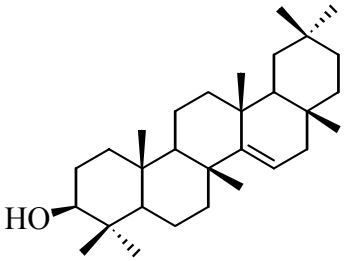


35h: R = O: 3-Oxo-taraxastane-20(*R* or *S*)-ol

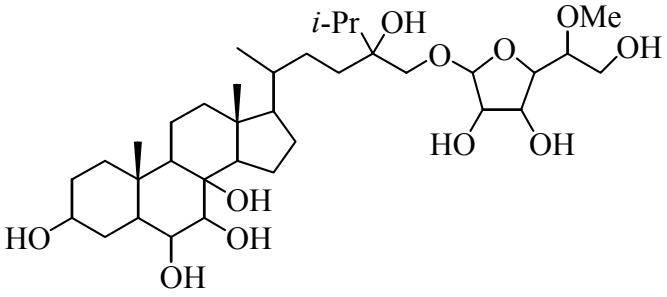
36h: R = α-H, β-OH: 3β,20-Diol-taraxastane



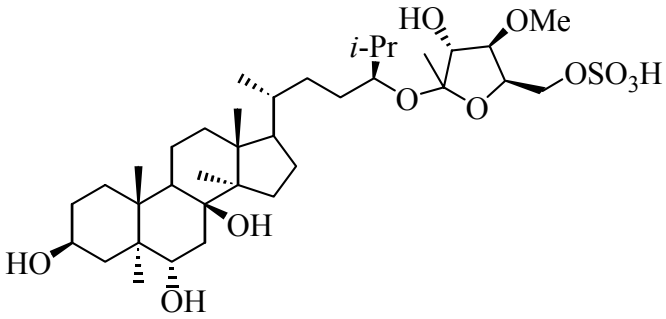
37h: Manghopanal



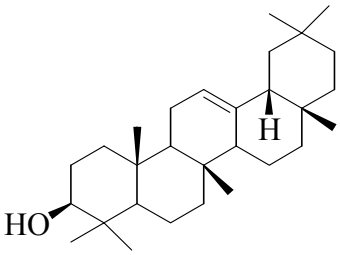
38h: Taraxerol



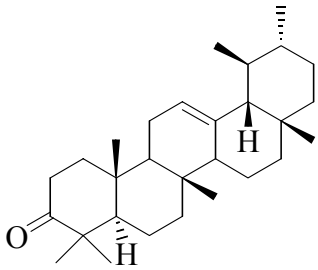
39h: Indicoside A



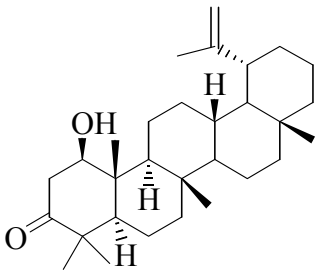
40h: Indicoside B



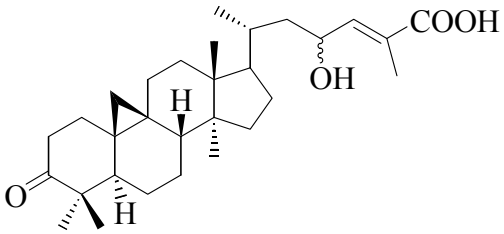
41h : β-Aminrone



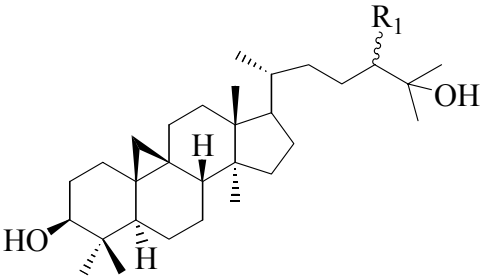
42h : α-Amirone



43h : Glochidonol



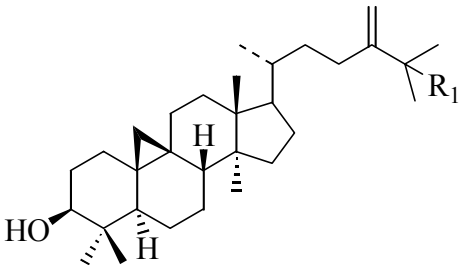
44h : 23(*R* or *S*)-Hydroxy-3-oxo-cycloart-24-en-26-oic acid



45h : R_1 = OH(*R*) : 3β,24(*R*),25-Triol-cycloartane

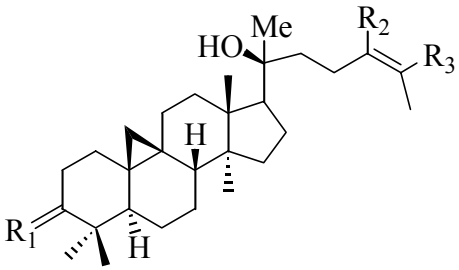
46h : R_1 = OH(*S*) : 3β,24(*S*),25-Triol-cycloartane

47h : R_1 = OH : 3β,24,25-Triol-cycloartane



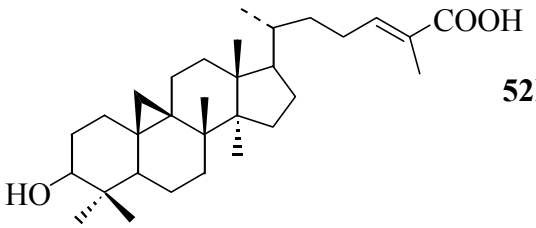
48h : R_1 = OH : 3β,26-Diol-24-methylene-cycloartane

49h : R_1 = H : 24-Methylene-cycloartane

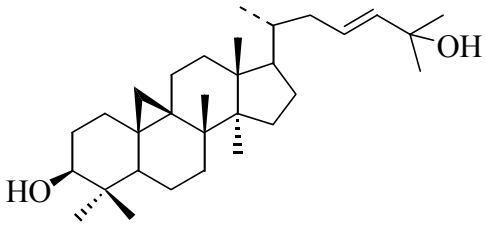


50h : R_1 = α-H β−OH, R_2 = H, R_3 = Me : 3β,20(*S*)-Diol-demmar-24-ene

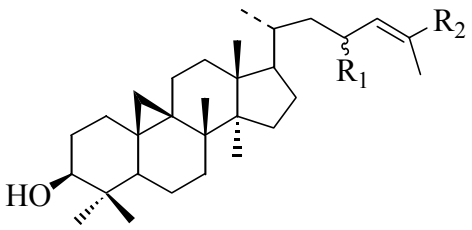
51h : R_1 = O, R_2 = Me, R_3 = OH : 20(*S*),26-Dial-3-keto-dammarane-trans-24-ene



52h : Hydroxy mangiferolic acid



54h : Cycloartane-23-en-3β,25-diol



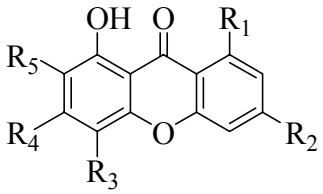
55h : R_1 = H, R_2 = CHO : 3β-Hydroxy-cycloart-24-en-26-al

56h : R_1 = OH(*R*), R_2 = COOH : 3β,23(*R*)-Hydroxy-cycloart-24-en-26-oic acid

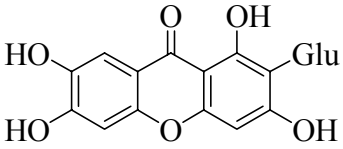
57h : R_1 = OH(*S*), R_2 = COOH : 3β,23(*S*)-Hydroxy-cycloart-24-en-26-oic acid

58h : R_1 = OH, R_2 = OH : 3β,26-Dihydroxy-cycloart-24-ene

i. Xanthones



1i : R_1, R_5 = OH, R_2, R_3, R_4 = H : Euxanthone
3i : R_1, R_2 , R_3, R_4, R_5 = OCH_3 : 1,3,5,6,7-Pentamethoxyxanthone
4i : R_1, R_2 , R_3, R_4, R_5 = OH : 1,3,6,7,8-Pentahydroxyxanthone



2i : R = OH : Mangiferin
5i : R = *O*-gallate : Mangiferin-6'-*O*-gallate

1.2.2 Biological activities of *Mangifera* species

Various species of genus *Mangifera* (Anacadiaceae) have been used in the folk medicine for various purposes. *M. indica* has been used in traditional medicine as vermifuge activity in India (Reddy, *et al*., 1998), as a gargle to treat swollen gums in Malaysia (Ong, *et al*., 1999). The stem bark of *M. indica* has been reported to possess antiviral, antibacterial, antiimflammatory, inmunomodulatory activity (Makare, *et al*., 2001), antiamoebic (Tana, *et al*., 1998) and antioxidation activity (Alberto, *et al*., 2002). In India, an aqueous and methanolic extracts of seeds have been reported as antidiarrhoeal activity (Sairam, *et al*., 2003). The ethanolic extract of the bark of *M. indica* showed the most potent α-glucosidase inhibitory activity (Prashanth, *et al*., 2001). The leaves of *M. foetida* and *M. odorata* have been used for the treatment of Antitumor-promoting activity (Maurakami, *et al.*, 1995 and Mooi, *et al*., 1999).

1.3 Objectives

One of the major changes that occur during processing, distribution, and final preparation of food is oxidation. Oxidation of fat initiates other change in the food systems that affects its nutritional quality, wholesomeness, safety, color, flavor, and texture. In addition, it is thought that lipid oxidation is strongly associated with carcinogenesis, mutagenesis, aging and atherosclerosis (Yagi, 1987; Cutlar, 1984;

1992). The addition of antioxidants have become popular as a means of increasing the shelf life of food products and improving the stability of lipid. In living system, dietary antioxidants such as β-carotene, α-tocopherol, and ascorbic acid may be effective in protection from oxidative damage as well as in enzymatic protection by endogenous enzymes such as superoxide dismutase, glutathione peroxidase, and catalase. Synthetic antioxidants, e.g. butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT) and *tert*-butyl hydroquinone (TBHQ), are widely used in the food industry because they are effective and cheaper than natural antioxidants. Their safety, however, has been questioned. Ito, *et al.,* (1986) reported that BHA was carcinogenic in animal experiments. At high doses, BHT may cause internal and external hemorrhaging, which contributes to death in some strain of mice and guinea pigs. This effect is due to the ability of BHT to reduce vitamin K-depending blood clotting factor (Ito *et al*., 1986). TBHQ is allowed as a food antioxidant in the U.S. However, it is not permitted in the European Economic Community countries and Canada due to the lack of adequate toxicological information acceptable to those countries. Moreover, it showed mutagenic activity *in vivo* (VanEach, 1986). Recently, several natural antioxidants from dietary plants, e.g. polyphenol or β-diketone have been reported to play an important role in prevention of carcinogenesis and to extend life span in animals (Osawa, *et al*., 1990). Dietary antioxidants were reported to offer effective protection against peroxidative damages in living systems (Cutlar, 1984; Osawa, *et al*., 1990; Hirose, *et al*., 1994). Therefore, much attention has been focused on natural antioxidants and some polyphenol compounds, e.g. flavonoids, phenolic acid and lignans. Flavonoids have received the most attention and much is known about the structural requirements for antioxidant activity. Based on NAPRALERT database and SciFinder Scholar, the antioxidation activity of chemical constituents isolated from *Mangifera odorata* has not been investigated. In addition, the preliminary testing on radical scavenging of the crude material of *M. odorata* exhibits potent activity. It then prompted us to investigate the components of *Mangifera odorata* more thoroughly and search for the antioxidation activity of pure compounds.