



Phytoconstituents and biological activities of *Vitex* - a review

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Abstract

A review of the phytoconstituents of the genus *Vitex* so far reported, has been presented considering that it is one of the largest genus which comprises of 250 species, and distributed all around the world. Only 28 species have been studied phytochemically. Keeping in view of the potential of the genus, an attempt is made to present a review of the phytoconstituents and biological activities of the genus *Vitex*, which still remain as a source for lead molecules.

Key words: *Vitex*, phytoconstituents, biological activities.

1. Introduction

The genus *Vitex* belonging to the family Verbenaceae is constituted by 250 species of small trees and shrubs, occurring in tropical to temperate regions [1]. Traditionally some of its species are being used for rheumatic pains, sprains, inflammation, as anti-tubercular, anti-cancer, diuretic, respiratory infections, in migraine, premenstrual problems, anti-fungal, and insecticidal. There are about 12 species available in India with medicinal value [2, 3].

About 28 species of this genus have been investigated phytochemically and were reported to contain flavonoids, terpenoids, ecdysteroids, iridoid glucosides etc. Due to abundance of bioactive constituents in this genus and research work intermittently published on *Vitex* species, it was felt worthwhile to present a phytochemical review of all the compounds isolated and the biological activities reported so far from the genus *Vitex*.

2. List of compounds isolated from the genus *Vitex*.

species	constituents isolated	ref.
<i>V. agnus-castus</i>	apigenin, vitexin, penduletin, β -caryophyllene	14
	vitexlactam	21
	6 β ,7 β -diacetoxy-13-hydroxy- λ -8,14-diene, rotundifuran, Vitexilactone	25

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species	constituents isolated	ref.
	agnucastoides A-C, aucubin, agnuside, mussaenosidic acid, 6'-O- <i>p</i> - hydroxybenzoylmussaenosidic acid, myzodendrone	29
	luteolin 6-C- (4"-methyl-6"-O-trans-caffeoylglucoside), luteolin 6-C- (6"-O-trans-caffeoylglucoside), luteolin 6-C- (2"-O-trans-caffeoylglucoside), luteolin 7-O- (6"- <i>p</i> -benzoylglucoside), 5, 4'-dihydroxy-3,6,7,3'-tetramethoxyflavone, luteolin, artemetin, isorhamnetin	31
	β -sitosterol, vitexin, isovitexin, casticin, agnuside, aucubin	32
	agnuside, Aucubin	40
	casticin, Vitexin	44
	casticin	45
	homoorientin	49
	aucubin, agnuside, casticin, orientin, nomoorientin, luteolin-7-glucoside	50
	quercetagetin-3,6,7,4'-tetramethyl ether casticin, 3,6,7,4'-tetramethyl ether of 6-hydroxy kaempferol, 3,6,7-trimethyl ether of 6-hydroxy kaempferol, 3,6,7-tri methyl ether of quercetagetin	82
	eurostoside, aucubin, agnuside	92
	terpinene-4-ol, α -cymene, limonene, α -terpineol, α -pinene, sabinene, 1,8-cineole	104
	testosterone, epitestosterone, progesterone, 17 α -hydroxyprogesterone, androstenedione	106
	alloaromadendrene, terpineol	114
	1,8-cineole, sabinene, α -pinene, limonene	115
	1,8-cineole, α -terpineol, β -sabinene, sabinene, β -caryophyllene, β -farnesene	126
	α -terpineol, 1,8-cineole, sabinene, β -caryophyllene, β -farnesene, α -terpenylacetate, α -pinene	127
	limonene, cineole, sabinene, α -terpineol, β -gurjunene, cuparene, globulol	133
	1,8-cineole, sabinene, β -farnesene	134
	limonene, cineole terpinene-4ol, α -humulene, cis- β -farnesene, scadinol, α -pinene, β -caryophyllene, α -terpineol, β -caryophyllene	136
	hexadeconoic acid, heptadeconoic acid, 9,12-octadecadienoic acid, 13-octadeconoic acid, octadeconoic acid, 9-octadeconoic acid	141
	α -pinene, β -caryophyllene, 1,8-cineole, β -farnesene, α -terpenylacetate, sabinene, bicyclogermacrene	151
	sabinene, β -caryophyllene, 8-cineole	156
	1,8-cineole-limonene mixture, α -terpineol, sabinene	160
	agnuside, aucubin	43,112
<i>V. altissima</i>	vitexin	52
<i>V. canescens</i>	24-epi-abutasterone, 20-hydroxyecdysone, 24-epi-makisterone A, shidasterone, calonysterone, turkesterone	18
	(24R)-11 α ,20,24-trihydroxyecdysone, 11 α ,20,26-trihydroxyecdysone	30
	20-hydroxyecdysone, turkesterone, canescensterone	121
<i>V.cannabifolia</i>	vitexilactone, agnuside, artemetin, <i>p</i> -hydroxybenzoic acid	70

species	constituents isolated	ref.
	isonishindaside, nishindaside	111
	methyl- <i>p</i> -hydroxybenzoate, aucubin, agnuside, negundoside, maltoglucoside	116
<i>V. cymosa</i>	26-hydroxypinnatasterone, 20-hydroxyecdysone	27
	oxygenated derivatives of copaene, phytol, isophytol	149
	viteoid, agnuside	155
<i>V. divaricata</i>	esters and their long chain alcohols	48
<i>V. doniana</i>	tannin, phytin, oxalate	98
	<i>n</i> -alkane, <i>n</i> -tritriacontane	113
	sucrose, reducing sugar, vitamin C	159
<i>V. fisherii</i>	vitexirone, 20-hydroxyecdysone, ajugasterone C, turkesterone	105
<i>V. glabrata</i>	11 α ,20-dihydroxyecdysone, 20-hydroxyecdysone	93
<i>V. leptobotrys</i>	2',4'-dihydroxy-4,6'-dimethoxychalcone, 4'-hydroxy-4,2',6'-trimethoxychalcone, 4,2',4', β -tetrahydroxy-6'-methoxy- α , β -dihydrochalcone	22
	ecdysterone, 24(28)-dehydromakisterone, makisterone A, 24-epi-makisterone A, ajugasterone C, deoxycrustecdysterone, pinnatasterone N-trans-feruloyltyramine, 2',4'-dihydroxy-4,6'-dimethoxychalcone, 4'-hydroxy-4,2',6'-trimethoxychalcone, 4,2',4', β -tetrahydroxy-6'-methoxy- α , β -dihydrochalcone	150
<i>V. leucoxylon</i>	β -sitosterol, dimethylterephthalate, vitexin, isovitexin, agnuside, aucubin	4,32
<i>V. limonifolia</i>	limonidilactone	17,120
	caryophyllene, caryophyllene oxide, α -pinene	103
	negundoside, limoniside, agnuside	147
<i>V. littoralis</i> (<i>V. lucens</i>)	vitexin	37,61
	isovitexin, homovitexin, vitexin, β -sitosterol	38
	saponaretin, isovitexin, homovitexin	39
	vitexin, β -sitosterol, 1-hexacosanol, pentatriacontane, stearic acid, β -carotene	41
	saponaretin, vitexin	42
	aucubin, agnuside, casticin, orientin, nomoorientin, luteolin-7-glucoside	50
	di-C-glucopyranosylluteolin, vicienin-1, vicienin-2, vicienin-3	51
	vitexin, isovitexin, orientin, isoorientin, vicienins, lucenins	53
	<i>O</i> - <i>D</i> -xylosylvitexin, <i>p</i> -hydroxybenzoylvitexin	60
<i>V. madiensis</i>	20-hydroxyecdysone	87
<i>V. megapotamica</i>	orientin, nomoorientin, vitex triterpene (C ₃₀ H ₅₀ O ₈)	50
	20-hydroxyecdysone	56
	pterosterone, polypodin B, viticosterone E, inokosterone, crustecdysone	59
	pterosterone, polypodin B, viticosterone E, inokosterone, agnuside	63
<i>V. negundo</i>	5 β -hydro-8,11,13-abietatrien-6 α -ol, lanostan-8,25-dien-3 β -ol, artemetin	6
	vitexicarpin	10

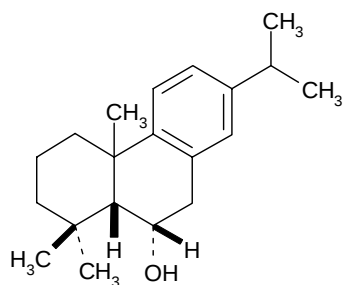
species	constituents isolated	ref.
	β -sitosterol, stigmasterol, vitexin, isovitexin, casticin, agnuside, aucubin	32
	luteolin 7-glucoside, α -D -glucoside ($C_{22}H_{24}O_{12}$), casticin	45
	casticin, agnuside, aucubin, luteolin 7-glucoside, orientin, nomoorientin	50
	5-hydroxy-3,6,7,3',4'-pentamethoxyflavone	58
	<i>n</i> -tritriacontane, <i>n</i> -hentriacontane, <i>n</i> -pentatriacontane, <i>n</i> -nonacosane,	
	β -sitosterol, γ -hydroxybenzoic acid, 5-oxyisophthalic acid	65
	B-sitosterol	66
	5-oxyisophthalic acid, <i>p</i> -hydroxybenzoic acid, glucose	68
	β -sitosterol, vanillic, luteolin, <i>p</i> -hydroxybenzoic acid	71
	methyl ether of leucodelphinidin, leucocyanidin-7-O - rhamnoglucoside	73
	glycine, alanine, valine, leucine	74
	6-C-glycosyl-5-O -rhamnopyranosyltrimethoxywogonin,	
	acerosin-5-O-glucoside mono acetate	75
	3,6,7,3',4'-pentamethoxy-5-O -glucopyranosyl rhamnoside,	
	vitexin caffeate, 4'-O -Me myricetin-3-O -[4''-O- β -D-galactosyl]- β -D-galactopyranoside	76
	α -pinene, δ^3 -carene, limonene, camphene, β -phellandrene,	
	17-methyl heptenone, <i>p</i> -cymene, linalool, 4-terpineol,	
	α -terpineol, citral, caryophyllene oxide, geraniol, caryophyllene,	77
	terpenyl acetate, geranyl acetate, benzaldehyde, cinnamaldehyde,	
	hentriacontane, β -sitosterol, β -sitosterol acetate, stigmasterol	78
	α -phellandrene, α -pinene, sabinene, β -pinene, 1,8-cineole,	
	<i>p</i> -cymene, γ -terpinene, 4-(terpinen-4-ol), β -elemene,	
	β -caryophyllene, caryophyllene oxide	79
	2'-p-hydroxybenzoylmussaenosidic acid	80
	furanoeremophilane, acetyl oleanolic acid, sitosterol	83
	6'-p -Hydroxy benzoyl mussaenosidic acid	84
	nishindaside, negundoside	85
	5,3'-dihydroxy-7,8,4'-trimethoxy flavanone, 5,3'-dihydroxy-6,7,4'-trimethoxy flavanone	86
	5-hydroxy-3,6,7,3',4'-pentamethoxy flavone, 3,5-dihydroxy-3,4,6,7-tetramethoxy flavonol	91
	5,7,3'-trihydroxy flavone, 6,8,4'-trimethoxy flavone	95
	4,4'-dimethoxy-trans-stilbene, 5,6,7,8,3',4',5'-heptamethoxy flavone,	
	5-hydroxy-6,7,8,3',4'-pentamethoxy-(5-O -desmethyl nobiletin)flavone,	
	5-hydroxy-6,7,8,4'-tetramethoxy flavone, 5-hydroxy-7,3',4',5'-tetramethoxy flavone, 4,4'-dimethoxy-trans- stilbene, 5,6,7,8,3',4',5'-heptamethoxy flavone, 5-hydroxy-6,7,8,3',4'-pentamethoxy-(5-O -desmethyl nobiletin)flavone, 5-hydroxy-6,7,8,4'-tetramethoxy flavone, 5-hydroxy-7,3',4',5'- tetramethoxy flavone	99
	chrysosplenol D, luteolin, D-fructose, isoorientin,	
	<i>p</i> -hydroxybenzoic acid, casticin	100
	α -phellandrene, α -pinene, β -pinene, 1,8-cineole, <i>p</i> -cymene,	
	β -elemene, β -caryophyllene, camphene, sabinene, β -phellandrene,	
	linalool, neral, geraniol, bornyl acetate, α -guaiene, β -guaiene,	
	δ -elemene, α -elemene, β -farnesene, caryophyllene epoxide, nerolidol, caryophyllenol F, farnesol, β -eudesmol, β -bisabolol, cedrol	102

species	constituents isolated	ref.
	3 β -acetoxyolean-12-en-27-oic acid, 2 α ,3 α -dihydroxyoleana-5,12-dien-28-oic acid, 2 β ,3 α -diacetoxyoleana-5,12-dien-28-oic acid, 2 α ,3 β -diacetoxy-18-hydroxyoleana-5,12-dien-28-oic acid	107
	6-hydroxy-4-(4-hydroxy-3-methoxyphenyl)-3-hydroxymethyl-7-methoxy-3,4-dihydro-2-naphthaldehyde	109
	nishindaside	111
	sabinene, β -caryophyllene, <i>p</i> -cymene, β -phellandrene, terpinen-4-ol, α -guaiene, spathulenol, β -caryophyllene oxide, globulol, viridifloral, bis-(1,1-dimethyl)methyl phenol, abieta-7,13-diene	118
	β -eudesmol	122
	agnuside, 2'- <i>p</i> -hydroxybenzoylmussaenosidic acid, 6'- <i>p</i> -hydroxybenzoylmussaenosidic acid, lagundinin	123
	5,3'-dihydroxy-7,8,4'-trimethoxy flavanone, 2'- <i>p</i> -hydroxybenzoylmussaenosidic acid, 5-hydroxy-3,6,7,3',4'-pentamethoxyflavone, luteolin 7-glucoside, agnuside, β -sitosterol, isoorientin, <i>p</i> -hydroxybenzoic acid, viridifloral, squalene, 5-hydroxy-3,7,3',4'-tetramethoxy flavone, 3,4-dihydroxybenzoic acid	139
	<i>p</i> -hydroxybenzoic acid, <i>n</i> -pentatriacontane, 5-hydroxyisophthalic acid	140
	β -sitosterol, <i>p</i> -hydroxybenzoic acid, betulinic acid, ursolic acid, <i>n</i> -hentriacontanol	142
	caryophyllene, eucalyptol, alloaromadendrene, β -farnesene	144
	caryophyllene oxide, sabinene, β -caryophyllene, γ -terpinene, β -caryophyllene oxide, viridifloral, 4-terpineol, 1-oceten-3-ol	145
	rotundial	146
	casticin, vitexilactone	148
	β -sitosterol, β -amyrin, epifriedelinol, oleanolic acid	158
<i>V. peduncularis</i>	pachypodol, ursolic acid, 2 α -hydroxy-ursolic acid, peduncularison, friedelin, epifriedelinol, peduncularisin, vitexin, β -sitosterol	8
	pedunculariside, agnuside	16
	stigmasterol, isovitexin, casticin, agnuside, aucubin, vitexin, β -sitosterol	32
	flavanone	35
	vitexin	7, 36, 46, 52
<i>V. pubescence</i> (<i>V. pinnata</i>)	β -sitosterol, stigmasterol, vitexin, isovitexin, casticin, agnuside, aucubin	32
	leucopelargonidol	54
	pinnatasterone, 20-hydroxyecdysone, turkesterone	110
<i>V. polygama</i>	2"- <i>O</i> -caffeoilyorientin, orientin, isoorientin, vitexin, isovitexin, luteolin, quercetin, quercetin-3- <i>O</i> -methylether, <i>p</i> -hydroxybenzoic acid	20
	20-hydroxyecdysone, ajugasterone C, ajugasterone C monoacetone, turkesterone	27
	hentriacontane, nonacosane, (+)-spathulenol	124
	α -pinene, β -pinene, limonene, δ -cadinene, β -caryophyllene	149
<i>V. pseudo-negundo</i>	agnuside, aucubin, ecdysterone	62
<i>V. rehmanni</i>	agnuside, aucubin, ecdysterone	62
<i>V. rotundifolia</i>	vitrofolal D-F, detetrahydroconidendrin and its isomer	9

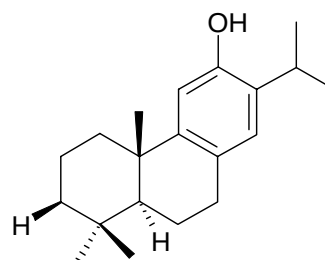
species	constituents isolated	ref.
	labdane-type diterpenes 1-8, ferruginol, abietatrien-3 β -ol	11
	vitexifolin A-E, vitetrifolin D, vrinor- γ -lactone, iso-ambreinolide, casticin, artemetin, 5,3'-dihydroxy-6,7,4'-trimethoxyflavanone	13
	viteoside A	19
	casticin, artemetin, 5,3'-dihydroxy-6,7,4'-trimethoxyflavanone	23
	1-(3,4-dimethoxyphenyl)-7-hydroxy-8-methoxynaphthalene-3-carbaldehyde, 1-(3,4-dimethoxyphenyl)-2,7-dihydroxy-8-methoxynaphthalene-3-carbaldehyde, 2,7-dihydroxy-1,9,10-trimethoxy-7H-benzo[c]fluorine-6-carbaldehyde	24
	2',3',5'-trihydroxy-3,6,7-trimethoxy flavone, vitexicarpin, artemetin	33,34
	vitexicarpin	57
	rotundifuran, Prerotundifuran	64
	artemetin, casticin	72
	(-)-vitalone	89
	vitexilactone, previtexilactone, <i>p</i> -hydroxybenzoic acid, vanillic acid	96
	phenyl butanone glucoside, agnuside, eurostoside	97
	<i>n</i> -hydrocarbon, β -sitosterol, 3- <i>O</i> - β -D-glucoside, hesperidin, vitexicarpin, artemetin, vanillic acid, luteolin	117
	vitexifolin A-C, 10- <i>O</i> -vanilloylaucubindihydrodehydrodiconiferyl alc.- β -D-(2'- <i>O</i> - <i>p</i> -hydroxybenzoyl) glucoside, vanilloyl- β -D-(2'- <i>O</i> - <i>p</i> -hydroxybenzoyl) glucoside, agnuside, erythroguaiacylglycerols, threoguaiacylglycerols	128
	erythroguaiacylglycerols, threoguaiacylglycerols, taxifolin, dihydrodehydrodeconiferyl alc., dihydrodehydrodeconiferyl alc.-9- <i>O</i> - β -D-glucoside, dihydrodehydrodiconiferyl alc.-(4-8)-erythro-guaiacyl glycerol ether, vanillic acid	129
	viteoids I, II, eucommiol, iridolactone, peduncularislactone, agnuside, 10- <i>O</i> -vanilloyl aucubin, 1-oxo-eucommiol	131
	δ^3 - careen, 1,8-cineole, sabinene, β -phellandrene, isoterpinolene	132
	luteolin, chrysosplenol D, penduletin, (25)-5-3'-dihydroxy-6,7,4'-trimethoxy flavanone	135
	abietane-9(11),12-diene, abietane-9(11),12(13)-di- α -epoxide	137
	α -pinene, 1,8-cineole, β -pinene, α -terpineol, sabinene, limonene, manoyloxide, terpene-4-ol	143
	rotundifuran	152
	rotundial	125,153
<i>V. rotundifolia</i>	(+)-polyalthic acid	5
<i>V. scabra</i>	24-epi-pinnasterone, scabrasterone, calonysterone, pterosterone, 24-epi-makisterone A, 20-hydroxyecdysone, polypodine B, ajugasterone C, pinnasterone, 11 α -hydroxyecdysone, 24-epi-abutasterone, 20,26-dihydroxyecdysone, turkesterone	12
<i>V. sereti</i>	agnuside, aucubin, ecdysterone	62
<i>V. strickeri</i>	ecdysone, 20-hydroxyecdysone	101
	20-hydroxyecdysone, ajugasterone C, abutasterone, 11 α -hydroxyecdysone, 20-hydroxyecdysone-20,22-monoacetone, ajugasterone C-20,22-monoacetone	108
<i>V. thyrsoflora</i>	20-hydroxyecdysone	90

species	constituents isolated	ref.
<i>V. trifolia</i>	vitexicarpin, viteosin A	15
	vitetrifolin D-G	26
	vitetrifolin A-C, rotundifuran, dihydrosolidagenone, abietatriene 3 β -ol,	28
	stigmasterol, vitexin, isovitexin, β -sitosterol, casticin, agnuside, aucubin	32
	luteolin 7-glucoside, α -D-glucoside	45
	vitricin	47
	casticin, luteolin 7-glucoside, aucubin, orientin, nomoorientin, agnuside	50
	agnuside	55
	artemetin, 7-desmethyl artemetin	67
	β -sitosterol, friedelin, β -sitosterol- β -D-glucoside, long chain hydrocarbon	69
	α -phellandrene, salinene, <i>p</i> -cymene, β -terpinene, 4-(terpinen-4-ol), β -elemene, β -caryophyllene, caryophyllene oxide, α -pinene, β -pinene, 1,8-cineole	79
	phenol, α -terpineol, α -pinene, β -pinene, 1,8-cineole, dulcitol, vanillic acid	81
	myristic acid, palmitic acid, stearic acid, palmitoleic acid, oleic acid, linoleic acid, paraffin, γ -tocopherol, β -sitosterol	88
	luteolin-7- <i>O</i> - β -D-glucuronide, luteolin-3'- <i>O</i> - β -D-glucuronide, isoorientin	94
	<i>p</i> -hydroxybenzoic acid, β -sitosterol, β -sitosterol-3- <i>O</i> -glucoside, casticin, 3,6,7-trimethyl-quercetagenin	130
	viteosin A	138
	α -pinene, sabinene, α -terpenylacetate, 1,8-cineole, methyl-8,11,14- heptadecatrienoate, squalene	157
	vitexin, <i>p</i> -hydroxybenzoic acid	119

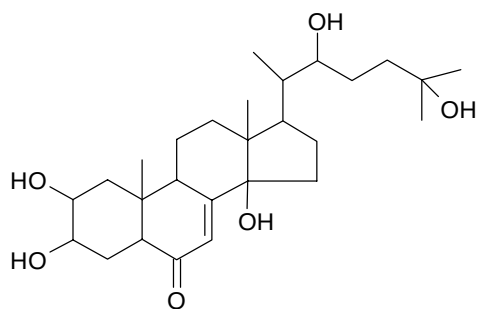
2. Frequently occurring compounds in *Vitex* species:



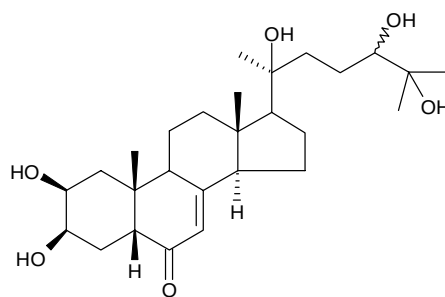
Abietatrien-6 α -ol



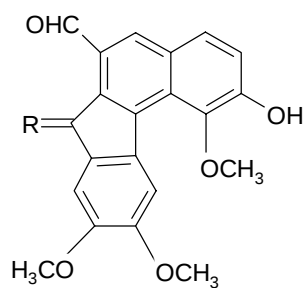
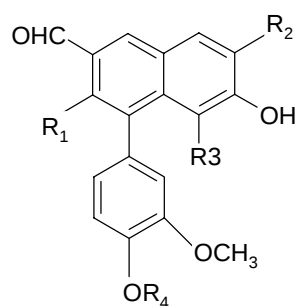
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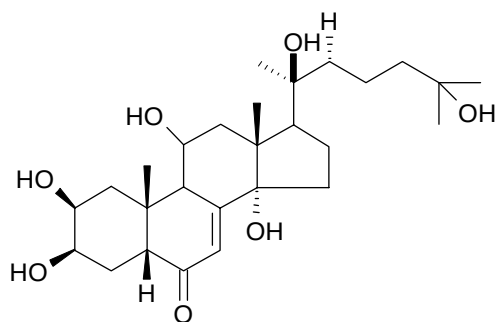
Ecdysone



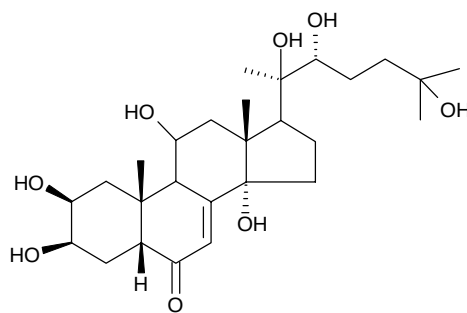
24-epi-pinnatasterone



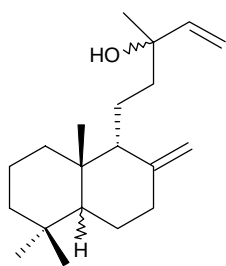
		R ₁	R ₂	R ₃	R ₄		R	
						Vitrofolal	C	OH
						Vitrofolal	D	O
Vitrofolal	A	A	H	OCH ₃	CH ₃			
Vitrofolal	B	OH	H	OCH ₃	CH ₃			
Vitrofolal	E	H	H	H	H			
Vitrofolal	F	OH	OCH ₃	H	H			



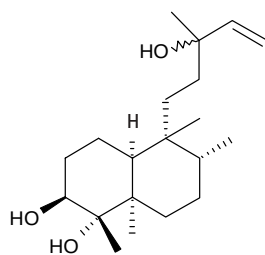
Scabrasterone



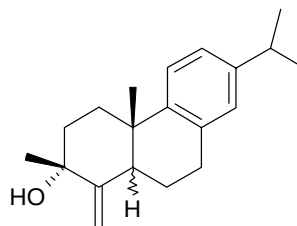
Turkesterone



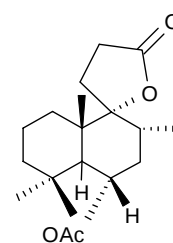
Vitexifolin A



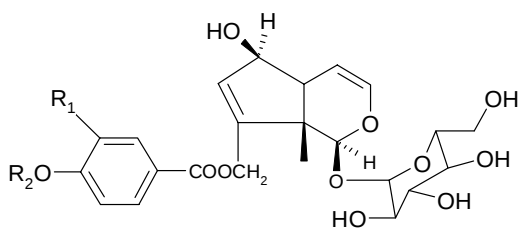
Vitexifolin B



Vitexifolin C

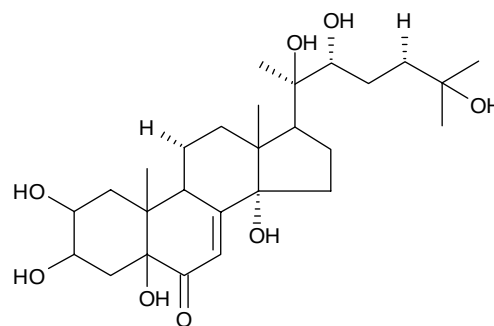


Vitexifolin D

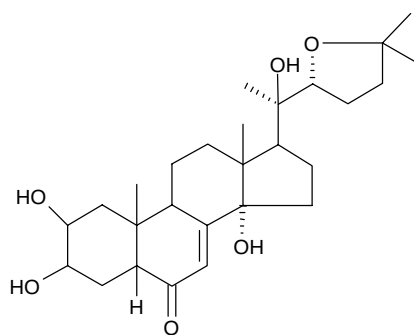


Agnuside
Pedunculariside
Limoniside

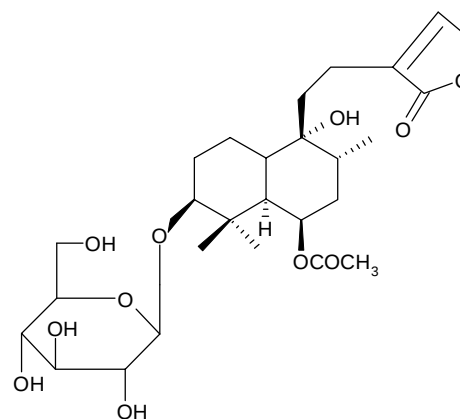
R_1	R_2
H	H
OCH_3	H
H	CH_3



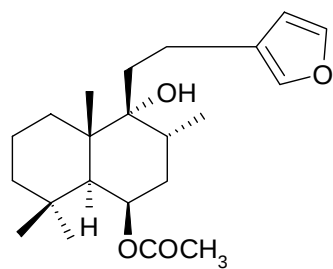
20-hydroxy ecdysone



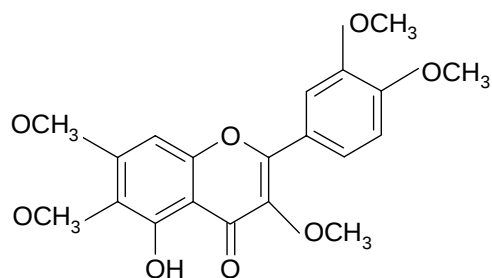
Shidasterone



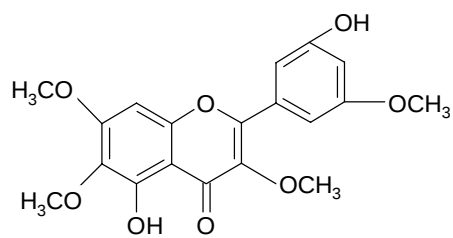
Viteoside A



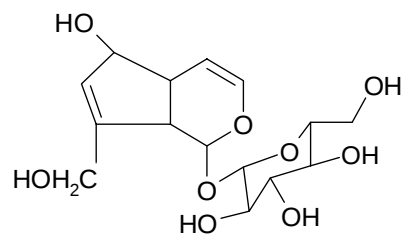
Rotundifuran



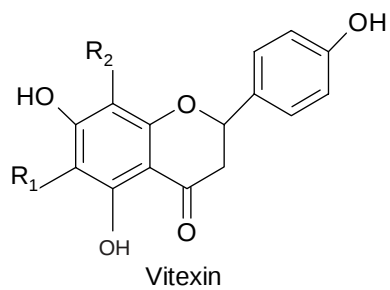
Artemetin



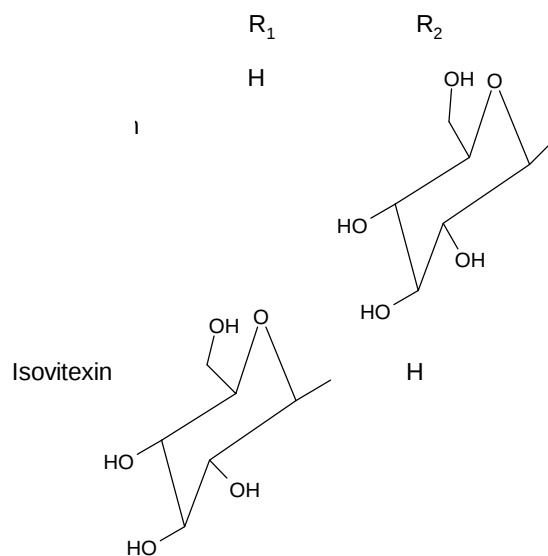
Casticin



Acubin



Vitexin



Isovitexin

3. Biological activities of *Vitex* species:

species name	category	ref.
<i>Vitex agnus-castus</i>	ACh antagonist	172
	anti-microbial	104, 174-176, 178, 179, 181, 182,186
	anti-acne	183
	anti-tumor	185
	cytotoxic	173, 187
	dopamenergic	188-196
	fertility	180, 201, 202
	toxic	214, 215
<i>Vitex cannabifolia</i>	uterine stimulant	216
<i>Vitex cofassus</i>	autonomic effect, CNS activity, toxicity	217
<i>Vitex congolensis</i>	CNS activity	218
<i>Vitex diversifolia</i>	analgesic, anti-microbial, anti-viral, anti-protozoan, diuretic, hypothermic, spasmolytic and anti-convulsant	177
<i>Vitex doniana</i>	hepatoprotective	219
	anti-microbial	220
	anti-hypertensive	221
<i>Vitex ficheri</i>	anti-microbial	222-224
<i>Vitex gardneriana</i>	uterine stimulant	216
<i>Vitex gaumeri</i>	anti-spasmodic	225
<i>Vitex heterophylla</i>	analgesic, anti-inflammatory, antiviral, diuretic, spasmolytic and toxicity	227
	anti-leishmaniasis	228
	analgesic, anti-convulsant, anti-protozoan, anti-viral, diuretic, hypothermic, spasmolytic and toxicity	177
<i>Vitex leucoxydon</i>	anti-microbial	170, 177
	anti-inflammatory	203
	HIV inhibition	229
<i>Vitex lucens</i>	anti-amoebic	230, 231
<i>Vitex madiensis</i>	anti-bacterial	230, 232
	anti-spasmodic	230
	autonomic effect	218
	anti-microbial	233
<i>Vitex mollis</i>	anti-microbial	233
<i>Vitex mombassae</i>	cytotoxic	234
<i>Vitex negundo</i>	abortifacient	235, 236
	analgesic	237-240
	anti-microbial	170, 244-249, 252, 253
<i>Vitex rotundifolia</i>	anti-filarial	250, 251
	hepatoprotective	254
	anti-inflammatory	107, 238, 240, 255, 256, 258, 260
(5 β -hydro-8,11,13-abietatrien-6 α -ol)	anti-oxidant	240, 264
	anti-spasmodic	238
	anti-tumor	265
	anti-viral	267, 268
	anti-spasmodic	269

species	name category	ref.
(vitexicarpin)	bronchodilator	100
	C.N.S. depressant, sleep time increased and toxic effect	239, 240
	cytotoxic	268, 271, 272,
	diuretic activity	257
	insect repellent	146, 279
	insecticide	281-284
<i>Vitex pubescence</i>	nematocidal	285, 286
	<i>Vitex polygama</i> antiviral	290
	hypotensive and cytotoxic	269
<i>Vitex quinata</i>	anti-bacterial	291, 292
<i>Vitex rotundifolia</i>	ACh inhibition	293
(vitrofolal A-D)	analgesic	135, 295
	anti-allergenic	288
	anti-anaphylactic	287
	anti-bacterial	280, 291, 292
	anti-cataract activity	278
	anti-inflammatory	277
	anti-spasmodic	276
	anti-oxidant	275
	uterine stimulant activity	274
	anti-tumor	273, 270
	anti-viral	261, 263, 243, 242
	cytotoxic	213, 226, 241, 273
	hypotensive	211, 212
	vasodilator	135
<i>Vitex trifolia</i>	abortifacient	161, 184, 206, 235
(viteosin-A, vitexicarpin)	anti-asthmatic, opiate receptor binding and ACh antagonist	197
	hypoglycemic, anti-inflammatory, analgesic and diuretic	161
	anti-ascariasis	198
	anti-microbial	161, 163, 165, 204, 205
	anti-oxidant	259, 340
	anti-pyretic	161, 200, 209
	anti-spasmodic	161, 207
	anti-trypanosomal	210
	anti-tumor	204
	anti-ulcer	200
	C.N.S. effects	199
	hypotensive	207, 294
	spasmolytic, cytotoxic and insecticide toxicity	165
		161, 266
	uterine stimulant	294

4. Conclusion

The genus *Vitex* has been carefully studied for its phytoconstituents as well as biological activities. Out of 250 species of this genus distributed all around the world, only 28 species have been phytochemically examined. Occurrence of the compounds like aucubin, agnuside, vitexin, casticin and 20-hydroxyecdysone are quite common in almost all the species examined. Hence the above compounds may be considered as chemotaxonomic markers of the genus *Vitex*. Nishindaside, viteralone and polypodine are very rare compounds seen in some of the

species of *Vitex*. Certain of the species like *V. agnus-castus*, *V. heterophylla*, *V. leucoxydon*, *V. mombassae*, *V. negundo*, *V. pubescens*, *V. rotundifolia* and *V. trifolia* possess cytotoxic principles. Many of the *Vitex* species reported, are rich in flavonoid compounds and tagged with anti-oxidant and anti-inflammatory activities. Some of the *Vitex* species are already in use in herbal formulations. Hence, exploration of this genus both phytochemically and biologically, is by no means exhaustive and there still remains more scope for the study of bioactive molecules.

References

- Mabberley DJ. (1997) *The plant-book: A Portable Dictionary of the Vascular Plants*, 2nd ed, Cambridge University Press : Cambridge, U.K; 749.
- Kirtikar JD, Basu BD. (1937) *Indian Medicinal Plants* Vol-III, 2nd ed; (1981) NISCOM: New Delhi.
- Chopra RN, Nayar SL, Chopra IC. (1956) *Glossary of Indian Medicinal Plants*, NISCOM: New Delhi; 56.
- Krishna Rao RV, Satyanarayana T, Ranjit Jena. (1997) *Indian Drugs* 34(1): 50-51.
- Mitsuo M, Hideo S, Nakamura S-I, Hiromu K. (1995) *J. Agric. Food Chem.* 43: 3012-3015.
- Chawla AS, Sharma AK, Handa SS. (1991) *Indian Journal of Chemistry* 30B : 773-776.
- Rao CB, Venkateswarlu V. (1962) *Sci. Ind. Research* 21B: 313.
- Niranjan PS, Subodh KR, Shashi BM. (1984) *Letter Planta Med.* 50(6): 527.
- Kazuyoshi K, Aki Y, Kimiko T, Shuko Y, Hirofumi S, Tomihiko H, Yoshihisa T. (2001) *J. Nat. Prod.* 64: 588-591.
- Fredyc D, Daniel C, Dongho L, Qiuwen M, Chai HB, Ghee TT, Leonardus BSK, Riswan S, Craig RF, Robert W, Norman RF, Geoffrey AC, John MP, Douglas KA. (2003) *J. Nat. Prod.* 66: 865-867.
- Masateru O, Megumi Y, Chikako M, Yasuyuki I, Masami Y, Toshihiro N. (1999) *J. Nat. Prod.* 62: 1532-1537.
- Apichart S, Saowanee K, Boon-ek Y. (2002) *J. Nat. Prod.* 65: 1690-1692.
- Masateru O, Takako Y, Megumi Y, Yasuyuki I, Toshihiro N. (2002) *J. Nat. Prod.* 65: 537-541.
- Hubertus J, Barbara S, Andrea P, Juergen S, Wolfgang W, Volker C. (2003) *Letter Planta Med.* 69 : 945-947.
- Gemini A, Subagus W, Ibnu GG, Lukman H, Timmerman H, Verpoorte R. (2002) *Letter Planta Med.* 68: 1047-1049.
- Suksamrarn A, Kumpun S, Kirtikara K, Yingyongnarongkul B, Suksamrarn S. (2002) *Letter Planta Med.* 68: 72-73.
- Stuhep A, Kloy N, Apichart S, Uncharee T. (1995) *Aust. J. Chem.* 48: 133-137.
- Apichart S, Nart P, Bordin C, Sureeporn H, Achara S. (1997) *Phytochemistry* 45(6): 1149-1152.

19. Masateru O, Yasuyuki I, Toshihiro N. (1998) *Phytochemistry* 48(1): 207-209.
20. Suzana GL, Franco DM. (1998) *Phytochemistry* 49(7): 2167-2169.
21. Sheng HL, Hong JZ, Sheng XQ, Xue MN, Bernard DS, Andrew DM, Harry HSF, Norman RF, Han DS. (2002) *Tetrahedron Letters* 43: 5131-5134.
22. Trinh TT, Andrea P, Helmut R, Tran VS, Gunter A. (1998) *Phytochemistry* 49(8): 2603-2605.
23. Junko K, Fumiko S-N, Masataka M, Yoshizumi M. (2004) *Cancer Letters* 208: 59-64.
24. Kazuyoshi K, Aki Y, Yoshihisa T. (1999) *Phytochemistry* 52: 1657-1659.
25. Eva H, Jimmy O, Beat M, Otto S. (1999) *Phytochemistry* 52: 1555-1558.
26. Masateru O, Yasuyuki I, Toshihiro N. (2001) *Chem. Pharm. Bull.* 49(9): 1220-1222.
27. Tereza CDS, Franco DM, Suzana GL. (2001) *Fitoterapia* 72: 215-220.
28. Masateru O, Hiromi S, Yasuyuki I, Koichi M, Toshihiro N. (2000) *Phytochemistry* 55: 873-877.
29. Ayse K-U, Karsten S, Omur DL, Axel Z. (2003) *Phytochemistry* 63: 959-964.
30. Suksamrarn A, Promrangsan N, Jintasirikul A. (2000) *Phytochemistry* 53: 921-924.
31. Chiko H, Zhi SQ, Koichi T, Hideji I. (1997) *Phytochemistry* 46(3): 521-524.
32. Krishna Rao RV, Ranjit J. (1996) *Indian J. Nat. Prod.* 12(2): 26-28.
33. Masateru O, Megumi Y, Takako Y, Yasuyuki I, Toshihiro N. (2001) *Chem. Pharm. Bull.* 49(1): 82-86.
34. Ko WG, Kang TH, Lee SJ, Kim NY, Kim YC, Sohn DH, Lee BH. (2000) *Food and Chemical Toxicology* 38: 861-865.
35. Sharma VN. (1955) *J. Sci. Ind. Research* 14B: 267-270.
36. Bheemashankara Rao CH, Venkateswarlu V. (1956) *Curr. Sci.* 25: 328.
37. Evans WH, McGookin A, Jurd L, Alexander R, Williamson WRN. (1957) *J. Chem. Soc.* 3510-3523.
38. Lindsay HB, Cambie RC. (1958) *Tetrahedron* 3: 269-273.
39. Cambie RC. (1959) *Chem. & Ind.* 87-88.
40. Hansel R, Winde E. (1959) *Arzneimittel-Forsch.* 9 : 189-190.
41. Cambie RC. (1959) *Newzealand J. Sci.* 2 : 230-236.
42. Margaret KS, Daphne JH, Rasma B. (1959) *Arch. Biochem. Biophys.* 85 : 272-273.
43. Winde E, Hansel R. (1960) *Arch. Pharm.* 293 : 556-567.
44. Belic I, Bergant DJ, Mortan RA. (1961) *J. Chem. Soc.* 2523-2525.
45. Sirait LM, Rimpler H, Haensel R. (1962) *Experientia* 18: 72.
46. Bheemasankara Rao CH, Venkateswarlu V. (1962) *J. Sci. Ind. Res.* 21B: 313-317.
47. Werner D. (1962) *Naturwissenschaften* 49: 375.
48. Wesley C, Shaw SJ. (1962) *J. Chem. Soc.* 4906-4909.
49. Hensel R, Rimpler H. (1963) *Arch. Pharm.* 296(9): 598-605.
50. Hensel R, Leuckert C, Rimpler H, Schaaf KD. (1965) *Phytochemistry* 4(1): 19-27.
51. Margaret KS, Mobry TJ. (1965) *Tetrahedron Letters* 16: 1105-1109.
52. Rao DS. (1965) *Naturwissenschaften* 52(10): 262.
53. Margaret KS, Juliana HSC, Linda F. (1966) *Phytochemistry* 5(3): 439-455.
54. Phana DK. (1965) *Trav. Lab. Matière Med. Pharm. Galenique Fac. Pharm.: Paris*; 50: 266.
55. Midan S, Frans L. (1966) *Suara Pharm.* 9(2): 47-51.
56. Rimpler H, Schulz. (1967) *Tetrahedron Lett.* (22): 2033-2035.

57. Yushiro K, Michio T, Yoshinori H. (1967) *Yakugaku zasshi* 87(11): 1429-1430.
58. Banerji A, Chadha MS, Malshet VG. (1969) *Phytochemistry* 8(2): 511-512.
59. Rimpler H. (1969) *Tetrahedron Lett.* (5): 329-333.
60. Alston RE. (1966) *Recent Advan. Phytochem.* 1: 305-27.
61. Bouillant ML, Chopin J. (1971) *C. R. Acad. Sci.* 273(25): 1759-1762.
62. Rimpler H. (1972) *Phytochemistry* 11(8): 2653-2654.
63. Rimpler H. (1972) *Arch. Pharm.* 305(10): 746-751.
64. Asaka Y, Kamikawa T, Kubota T. (1973) *Chem. Lett.* (9): 937-940.
65. Gupta GS, Behari M. (1973) *J. Indian Chem. Soc.* 50(5): 367-368.
66. Vidya J, Merchant JR, Nadkarny VV, Krishna N, Vaghani DD. (1974) *Indian J. Chem.* 12(2): 226.
67. Nair AGR, Ramesh P, Subramanian SS. (1975) *Curr. Sci.* 44(7): 214-216.
68. Gupta GS, Sharma DP. (1973) *Proc. Natl. Acad. Sci. India, Sect. A* 43(3) : 268-270.
69. Vedantham TNC, Subramanian SS. (1976) *Indian J. Pharm.* 38(1): 13.
70. Taguchi H. (1976) *Chem. Pharm. Bull.* 24(7): 1668-1670.
71. Rao VK, Rao EV, Rao DV. (1977) *Indian J. Pharm.* 39(2): 41.
72. Chen YL, Wang Y-S, Kao B-C, Chang YA. (1978) *Chung-Kuo Nung Yeh Hua Hsueh Hui Chih* 16(1-2): 99-102.
73. Subramanian PM, Misra GS. (1978) *Indian J. Chem. Sect.B* 16B(7): 615-616.
74. Gupta GS, Behari M. (1976) *Agra Univ. J. Res. Sci.* 25(1): 63-65.
75. Subramanian PM, Misra GS. (1979) *J. Nat. Prod.* 42(5): 540-542.
76. Misra GS, Subramanian PM. (1980) *Planta Med.* 38(2): 155-160.
77. Taneja SC, Gupta RK, Dhar KL, Atal CK. (1979) *Indian Perfum.* 23(3-4): 162-163.
78. Mukherjee KS, Badruddoza S. (1981) *J. Indian Chem. Soc.* 58(1): 97-98.
79. Fan J, Pan J, Sun Y, Ciu M, He H, Duan S, Wang X, Liu S, Sun Y. (1981) *Zhongcaoyao* 12(9): 393-396.
80. Sehgal CK, Taneja SC, Dhar KL, Atal CK. (1982) *Phytochemistry* 21(2): 363-366.
81. Higa M, Yogi S, Hokama K. (1983) *Bull. Coll. Sci., Univ. Ryukyus* 35 : 61-66.
82. Wollenweber E, Mann K. (1983) *Planta Med.* 48(2): 126-127.
83. Vishnoi SP, Shoeb A, Kapil RS, Popli SP. (1983) *Phytochemistry* 22(2): 597-598.
84. Sehgal CK, Taneja SC, Dhar KL, Atal CK. (1983) *Phytochemistry* 22(4): 1036-1038.
85. Dutta PK, Chowdhury US, Chakravarty AK, Achari B, Pakrashi SC. (1983) *Tetrahedron* 39(19): 3067-3072.
86. Achari B, Chowdhury US, Dutta PK, Pakrashi SC. (1984) *Phytochemistry* 23(3): 703-704.
87. Kubo I, Matsumoto A, Ayafor JF. (1984) *Agric. Biol. Chem.* 48(6): 1683-1684.
88. Prasad YR, Nigam SS. (1982) *Proc. Natl. Acad. Sci. India, Sect. A* 52(3): 336-339.
89. Tada H, Yasuda F. (1984) *Heterocycles* 22(10): 2203-2205.
90. Kubo I, Matsumoto A, Hanke F, Ayafor JF. (1985) *J. Chromatogr.* 321(1): 246-248.
91. Ferdons AJ, Jabbar A, Hasan CM. (1984) *J. Bangladesh Acad. Sci.* 8(2): 23-27.
92. Goerler K, Oehlke D, Soicke H. (1985) *Planta Med.* (6): 530-531.
93. Warawattanametin K, Podimvang V, Suksamrarn A. (1986) *J. Nat. Prod.* 49(2): 364-365.
94. Ramesh P, Nair AGR, Subramanian SS. (1986) *Fitoterapia* 57(4): 282-283.

95. Bhargava SK. (1986) *Plant. Med. Phytother.* 20(2): 188-198.
96. Kondo Y, Sugiyama K, Nozoe S. (1986) *Chem. Pharm. Bull.* 34(11): 4829-4832.
97. Kouno I, Inoue M, Onizuk Y, Fujisaki T, Kawano N. (1988) *Phytochemistry* 27(2): 611-612.
98. Balogun AM, Fetuga BL. (1988) *Food Chem.* 30(1): 37-43.
99. Banerji J, Das B, Chakraborty R, Jha H. (1988) *Indian J. Chem. Sect. B* 27B(6): 597-599.
100. Dayrit FM, Rosario GLM, Cagampang JV, Lagurin LG. (1987) *Philipp. J. Sci.* 116(4): 403-410.
101. Matsumoto T, Kubo I. (1988) *Jpn. Kokai Tokkyo Kho JP* 01, 135: 794.
102. Sun L. (1989) *Linchan Huaxue Yu Gongye* 9(1): 42-47.
103. Suksamrarn A, Aphaijitt S, Brophy JJ. (1990) *Flavour Fragrance J.* 5(1): 53-55.
104. Ekundayo O, Laakso I, Holopainen M, Hitunen R, Oguntimein B, Kauppinen V. (1990) *J. Essen. Oil Res.* 2(3): 115-119.
105. Kubo I, Asaka Y, Stout MJ, Nakatsu T. (1990) *J. Chem. Ecol.* 16(8): 2581-2588.
106. Saden KM, Kustrak D, Blazevec N. (1991) *Acta Pharm. Jugosl.* 41(3): 237-241.
107. Chawla AS, Sharma AK, Handa SS, Dhar KL. (1992) *J. Nat. Prod.* 55(2): 163-167.
108. Zhang M, Stout M. (1992) *Phytochemistry* 31(1): 247-250.
109. Chawla AS, Sharma AK, Handa SS, Dhar KL. (1992) *Phytochemistry* 31(12): 4378-4379.
110. Suksamrarn A, Sommechai CH. (1993) *Phytochemistry* 32(2): 303-306.
111. Iwagawa T, Nakahara A, Nakatani M. (1993) *Phytochemistry* 32(2): 453-454.
112. Kustrak D, Antolic A. (1992) *Farm. Glas.* 48(11): 305-310.
113. Adelakun EA. (1992) *Ghana J. Chem.* 1(5): 249-253.
114. Elgengaihi SE, Motawe HM, Omer EA, El-Bazza ZE. (1992) *Indian perfum.* 36(4): 293-296.
115. Kustrak D, Kuftinec J, Blazevec N. (1994) *J. Essent. Oil Res.* 6(4): 341-344.
116. Iwagawa T, Nakahara A, Miyauchi A, Okamura H, Nakatani M. (1993) *Kagoshima Daigaku Rigakubu Kiyo, Sugaku, Butsurigaku, Kagaku* 26: 57-61.
117. Kang SS, Kim JS, Kim HJ, Jung YR, Shin SW. (1994) *Saengyak Hakhoechi* 25(3): 214-220.
118. Gopal MR, Ramesh S, Kaul PN, Bhattacharya AK, Rao KRR. (1994) *Planta Med.* 60(6): 583-584.
119. Zhang Z, Wei Y, Lun, Zhang S, Gao L. (1994) *Tianran Chanwu Yanjiu Yu Kaifa* 6(3): 59-62.
120. Aphaijitt S, Nimgirawath K, Suksamrarn A, Tooptakong U. (1995) *Aust. J. Chem.* 48(1): 133-137.
121. Suksamrarn A, Sommechai C, Charulpong P, Chitkul B. (1995) *Phytochemistry* 38(2): 473-476.
122. Dayrit FM, Trono CM, Belen M-R, Maini H. (1995) *Philipp. J. Sci.* 124(1): 15-27.
123. Dayrit FM, Lagurin LG. (1994) *Philipp. J. Sci.* 123(4): 293-304.
124. Barbosa LCA, Demuner AJ, Howarth OW, Pereira NS, Veloso DP. (1995) *Fitoterapia* 66(3): 279-280.
125. Watanabe K, Takada Y, Matsuo N, Nishimura H. (1995) *Biosci. Biotechnol. Biochem.* 59(10): 1979-1980.
126. Senatore F, Porta GD, Reverchon E. (1996) *Flavour Fragrance J.* 11(3): 179-182.
127. Galletti GC, Russo MT, Bocchini P. (1996) *Rapid Commun. Mass Spectrom* 10(11): 1345-1350.
128. Okuyama E, Fujimori S, Yamazaki M, Deyama T. (1998) *Chem. Pharm. Bull.* 46(11): 655-662.
129. Ono M, Masuoka CH, Ito Y, Nohara T. (1998) *Food Sci. Technol. Int., Tokyo* 4(1): 9-13.

130. Zeng Y, Fang Z, Wu Y, Zhang H. (1996) *Zhongguo Zhongyao Zazhi* 21(3): 167-168.
131. Ono M, Ito Y, Kubo S, Nohara T. (1997) *Chem. Pharm. Bull.* 45(6): 1094-1096.
132. Li Z, Liu S. (1997) *Sepu* 15(4): 344-346.
133. Males Z, Blazevic N, Autolic A. (1998) *Planta Med.* 64(3): 286-287.
134. Moudachirou M, Ayedoun MA, Sossou PV, Garneau F-X, Gagnon H, Jean F-I. (1998) *J. Essent. Oil Res.* 10(3): 343-344.
135. Okuyama E, Suzumura K, Yamazaki M. (1998) *Nat. Med.* (Tokyo) 52(3): 218-225.
136. Males Z, Blazeric N. (1998) *Pharmazie* 53(10): 728-729.
137. Sakurai A, Okamoto Y, Kokubo S, Chida A. (1999) *Nippon Kagaku Kaishi* (3): 207-211.
138. Alam G, Ari SBS, Astuti P, Wahyuono S. (2002) *Majalah Farmasi Indonesia* 13(4): 180-184.
139. Singh V, Dayal R, Bartley JP. (2003) *J. Med. Aroma. Plant Sci.* 25(1): 94-98.
140. Kaushik RD, Kumar A, Arora CH. (2003) *Asian J. Chem.* 15(3&4): 1659-1664.
141. Cengiz M, Bardakci Z, Erodogan Y, Olgun A. (2003) *Internat. J. Chem.* 13(3): 127-131.
142. Chandramu C, Manohar RD, Krupadanam DGL, Dashavantha RV. (2003) *Phytother. Res.* 17(2): 129-134.
143. Soo-Jung, Kim Y-H, Kim M-K, Kim K-W, Yun S-E. (2002) *Hanguk Nonghwa Hakhoechi* 45(2): 101-107.
144. Chen Z-F, Li Y-H, Chen X-L. (1999) *Xibei Zhiwu Xuebao* 19(2): 354-356.
145. Singh V, Dayal R, Bartley JP. (1999) *Planta Med.* 65(6): 580-582.
146. Amancharla PK, Muthuraj PS, Rao GV, Singh OV. (1999) *Natural Product Sci.* 5(2): 104-106.
147. Suksamrarn S, Kumcharoen S, Suksamrarn A. (1999) *Planta Med.* 65(4): 392.
148. Ragasa CY, Morales E, Rideout JA. (1999) *Philippine J. Sci.* 128(1): 21-29.
149. Leitao SG, Fonseca EN, Dos STC. (1999) *Acta Horticulturae* 1997: 89-92.
150. Trinh TT, Trans VS, Porze A, Ripperger H, Adam G. (1999) *Tap Chi Hoa Hoc* 37(1): 16-22.
151. Zoghbi MDGB, Andrade EHA, Maia JGS. (1999) *Flavour and Fragrance J.* 14(4) : 211-213.
152. Ko WG, Kang TH, Lee SJ, Kim YC, Lee BH. (2001) *Phytother. Res.* 15(6) : 535-537.
153. Nishimura H. (2001) *Aroma Res.* 2(3): 257-264.
154. Thoy TT, Sung TV, Adam G. (2000) *Tap Chi Hoa Hoc* 38(2): 1-7.
155. Dos STC, Schripsema J, Monache FD, Leitao SG. (2001) *J. Brazilian Chem. Soc.* 12(6): 763-766.
156. Senatore F, Napolitano F, Ozean M. (2003) *J. Essent. Oil Bearing Plants* 6(3): 185-190.
157. Hoang VL. (2003) *Tap Chi Dvoc Hoc* (7): 13-14.
158. Krishna V, Sharma S, Pareek RB, Singh P. (2002) *J. Indian Chem. Soc.* 79(6) : 550-552.
159. Abu JD. (2002) *Int. J. Food Prop.* 5(1): 153-159.
160. Rodriguez-Lopez V, Salazar L, Estrada S. (2003) *Fitoterapia* 74: 725-728.
161. Dhawan BN, Patnaik GK, Rastogi RP, Singh KK, Tandon JS. (1977) *Indian J. Exp. Biol.* 15: 208-219.
162. Tae-Yong S, Sug HK, Jong PL, Eun SS, Hyun JJ, Byung DK, Eun JP, Woo JH, Do GR, Seung HB, Nyeon HA, Hyung MK. (2000) *J. Ethno Pharmacol.* 72: 443-450.
163. Hossain MM, Paul N, Sohrab MH, Rahman E, Rashid MA. (2001) *Fitoterapia* 72: 695-697.
164. Kornkanok I, Prapapan T, Kanchanaporn C, Thitaree Y, Warawit T. (2003) *J. Ethno Pharmacol.* 89: 261-264.
165. Hernandez MM, Heraso C, Villarreal ML, Vargas AI, Aranda E. (1999) *J. Ethno Pharmacol.* 67: 37-44.

166. Lohezic LDF, Bakhtiar A, Bezivin C, Amoros M, Boustie J. (2002) *Fitoterapia* 73: 400-405.
167. Toshiya M, Sigetomo Y, Yasuo O, Yoshio T, Tomochika T, Tadao A, Ayumi S, Mami N. (1999) *J. Agric. Food Chem.* 47: 1749-1754.
168. Kunio O, Takenori A, Chieko H, Toshio Y. (2003) *Biol. Pharm. Bull.* 26(1): 10-18.
169. Jeevan Ram A, Bhakshu L Md, Venkataraju RR. (2004) *J. Ethno Pharmacol.* 90: 353-357.
170. Valsaraj R, Pushpangadan P, Smitt UW, Adersen A, Nyman U. (1997) *J. Ethno Pharmacol.* 58: 75-83.
171. Baurin N, Arnoult E, Scior T, Do QT, Bernard P. (2002) *J. Ethno Pharmacol.* 82: 155-158.
172. Meier B, Berger D, Hoberg E, Sticher O, Schaffner W. (2000) *Phytomedicine* 7(5): 373-381.
173. Liu J, Burdette JE, Xu H, Gu C, Van Breemen RB, Bhat KPL, Booth N, Constantinou AI, Pezzuto JM, Fong HHS, Fransworth NR, Bolton JL. (2001) *J. Agr. Food Chem.* 49(5): 2472-2479.
174. Pepelinjak S, Antolic A, Rustrek D. (1996) *Acta Pharm.* 46: 201-206.
175. Mishurova SS, Malinovskaya TA, Akhmedov IB, Mamedov DG. (1986) *Rast Resur* 22(4): 526-530.
176. El-Keltawi NEM, Megalla SE, Ross SA. (1980) *Herba Pol.* 26(4): 245-250.
177. Bhakuni DS, Goel AK, Jain S, Mehrotra BN, Patnaik GK, Prakash V. (1988) *Indian J. Exp. Biol.* 26(11): 883-904.
178. Kustrak D, Pepelnjak S, Antolic A, Blazevic N. (1987) *Pharm. Weekbl. (SCI. ED.)* 9(4): 238.
179. Ross SA, El-Keltawi NE, Megalla SE. (1980) *Fitoterapia* 51: 201-205.
180. Gujral ML, Varma DR, Sareen KN. (1960) *Indian J. Med. Res.* 48: 46-51.
181. Kubas J. (1972) *Acta Biol. Cracov Ser. Bot.* 15: 87-100.
182. Guerin JC, Reveillere HP. (1985) *Ann. Pharm. FR.* 43(1): 77-81.
183. Amann W. (1975) *Z Allg. Med.* 35: 1645-1647.
184. Prakash AO, Mathur R. (1976) *Indian J. Exp. Biol.* 14: 623-626.
185. Ng SSW, Figg WD. (2003) *Anticancer Res.* 23 (5A): 3585-3590.
186. Kubas J. (1972) *Acta Biol. Cracov Ser. Bot.* 15: 101-112.
187. Ohyama K, Akaike T, Hirobe C, Yamakawa T. (2003) *Biol. Pharm Bull.* 26(1): 10-18.
188. Wuttke W, Gorkow C, Jarry H. (1995) *Phytopharmaka Forsch Klin Anwend* : 81-91.
189. Spengler B, Jarry H, Wuttke W, Christoffel V. (2000) *Phytomedicine Suppl.* 7(2): 118.
190. Jarry H, Metten M, Wuttke W. (2000) *Phytomedicine Suppl.* 7(2): SL-6B.
191. Jarry H, Leonhardt S, Gorkow C, Wuttke W. (1994) *Exp. Clin. Endocrinol.* 102: 448-454.
192. Seidl MM, Stewart DE. (1998) *Can. Fam. Phys.* 44: 1299-1308.
193. Jarry H, Spengler B, Wuttke W, Christoffel V. (2000) *Phytomedicine Suppl.* 7(2): SL6A.
194. Weisskopf M, Simmen U, Schaffner W. (2000) *Phytomedicine Suppl.* 7: 117.
195. Sliutz G, Speiser P, Schultz AM, Spona J, Zeillinger R. (1993) *Horm. Metab Res.* 25(5): 253-255.
196. Odenthal KP. (1998) *Phytother Res. Suppl.* 12(1): S160-S161.
197. Ingkaninan K, Hazekamp A, Hoek AC, Balconi S, Verpoorte R. (2000) *J. Liq. Chromatogr.* 23(14): 2195-2208.
198. Kaleysa RR. (1975) *Indian J. Physiol. Pharmacol.* 19: 47-49.
199. Cox PA, Sperry LB, Tuominen M, Bohlin L. (1989) *Econ. Bot.* 43(4): 487-497.
200. Yamazaki M, Maebayashi Y, Iwase N, Kaneko T. (1988) *Chem. Pharm. Bull.* 26(6): 2070-2074.

201. Cahill DJ, Fox R, Wardle PGL, Harlow CR, Propping D. (1995) *Human Reprod.* 10(8): 2175.
202. Cahill DJ, Fox R, Wardle PGL, Harlow CR. (1994) *Human Reprod.* 9(8): 1469-1470.
203. Sarma SP, Aithal KS, Srinivassan KK, Udupa AL, Kumar VV, Kulkarni DR, Rajgopal PK. (1990) *Fitoterapia* 61(3): 263-265.
204. Sundarrao K, Burrows I, Kudduk M, Yi YD, Chung MH, Suh NJ, Chung IM. (1993) *Int. J. Pharmacog.* 31(1): 3-6.
205. Mackeen MM, Khan MN, Samadi Z, Lajis NH. (2000) *Nat. Prod. Sci.* 6(3): 131-134.
206. Barnes CS, Price JR, Hughes RL. (1975) *Lloydia* 38(2): 135.
207. Mokkahasmit M, Ngarmwathana W, Sawasdimongkol K, Permiphaphat U. (1971) *J. Med. Ass. Thailand* 54(7): 490-504.
208. Masuda T, Yonemori S, Oyama Y, Takeda Y, Tanaka T, Andoh T, Shinohara A, Nakata M. (1999) *J. Agr. Food Chem.* 47(4): 1749-1754.
209. Ikram M, Khattak SG, Gilani SN. (1987) *J. Ethnopharmacol.* 19(2): 185-192.
210. Kiuchi F, Matsuo K, Itano Y, Ito M, Honda G, Oui TK, Nakajima Shimada J, Aoki T. (2002) *Natural Med.* 56(2): 64-68.
211. Ko ST, Moon YH, Ko OH. (1977) *Korean J. Biochem.* 8(2): 55-60.
212. Ko ST, Moon YH, Ko OH. (1977) *Korean J. Pharmacog.* 8: 55.
213. Sato A. (1989) *Yakugaku Zasshi* 109(6): 407-423.
214. Shuster J. (1997) *Nursing* 97: 75.
215. Loch EG, Selle H, Boblitz N. (2000) *J Women's Health Gender-Based Med* 9(3): 315-320.
216. Barros GSG, Matos FJA, Vieira JEV, Sousa MP, Medeiros MC. (1970) *J. Pharm. Pharmacol.* 22: 116.
217. Worthley EG, Schott CD. (1969) *Life Sci.* 8: 225-238.
218. Sandberg F, Cronlund A. (1977) *Proc. Third Asian Symposium Med Plants & Spices Colombo Sri Lanka February 6-12* 3: 178-197.
219. Ladji O, Okoye ZS. (1996) *Indian J. Pharmacy* 34 5: 355-358.
220. Awachie PIA, Ugwu FO. (1997) *Int. J. Pharmacog.* 35(5): 338-343.
221. Ladeji O, Okoye ZSC, Uddoh F. (1996) *Phytother. Res.* 10(3): 245-247.
222. Khan MR, Ndaalio G, Nkunya MH, Wevers H, Sawhney AN. (1980) *Planta Med. Suppl.* 40: 91-97.
223. Sawhney AN, Khan MR, Ndaalio G, Nkunya MHH, Wevers H. (1978) *Pak. J. Sci. Ind. Res.* 21(5/6): 189-192.
224. Sawhney AN, Khan MR, Ndaalio G, Nkunya MHH, Wavers H. (1978) *Pak. J. Sci. Ind. Res.* 21: 193-196.
225. Shish DF, Ueda H, Arvigo R, Balick MJ. (1999) *J. Ethnopharmacol.* 66(2): 159-165.
226. Bae KH, Min BS, Do DS, Kim NS, Yang GJ, Ahn BZ. (1992) *Yakhak Hoe Chi.* 36(5): 491-495.
227. Abraham Z, Bhakuni SD, Garg HS, Goel AK, Mehrotra BN, Patnaik GK. (1986) *Indian J. Exp. Biol.* 24: 48-68.
228. Singha UK, Guru PY, Sen AB, Tandon JS. (1992) *Int. J. Pharmacog.* 30(4): 289-295.
229. Wan M, Bloor S, Foo LY, Loh BN. (1996) *Phytother. Res.* 10(7): 589-595.
230. Tona L, Kambu K, Mesia K, Cimanga K, Aspers S, De Bruyne T, Pieters L, Totte J. (1999) *Phytomedicine* 6(1): 59-66.
231. Tona L, Kambu K, Ngimbi N, Cimanga K, Vlietinck AJ. (1998) *J. Ethnopharmacol.* 61(1): 57-65.
232. Lutete T, Kambu K, Ntondele D, Cimanga K, Luki N. (1994) *Fitoterapia* 65(3): 276-278.
233. Dimayuga RE, Virgen M, Ochoa N. (1998) *Pharmaceutical Biol.* 36(1): 33-43.
234. Chapuis JC, Sordat B, Hostettmann K. (1988) *J. Ethnopharmacol.* 23(2/3): 273-284.
235. Runnebaum B, Rabe T, Kiesel L, Prakash AO. (1984) *Future Aspects in Contraception.*

- Part 2. Female Contraception, MTP Press LTD: Boston, USA ; 115-128.
236. Kamboj VP. (1988) *Indian J. Med. Res.* 4: 336-355.
 237. Shrivastava SC, Sisodia CS. (1970) *Indian Vet. J.* 47: 170-175.
 238. Telang RS, Chatterjee S, Varshneya C. (1999) *Indian J. Pharmacol.* 31: 363-366.
 239. Gupta M, Mazumder UK, Bhawal SR. (1999) *Indian J. Exp. Biol.* 37(2): 143-146.
 240. Dharmasiri MG, Jayakody JRDC, Galhena G, Liyanage SSP, Ratnasooriya WD. (2003) *J. Ethnopharmacol.* 87(2/3): 199-206.
 241. Park JG, Hyun JW, Lim KH, Shin JE, Won YJ, Yi YD, Shin KH, Chang IM, Woo WS. (1993) *Korean J. Pharmacog.* 24(3): 223-230.
 242. Minshi Z. (1989) *J. Trad. Chin. Med.* 9(2): 113-116.
 243. Zheng MS. (1988) *J. Trad. Chin. Med.* 8(3): 203-206.
 244. Ahmad I, Mehmood Z, Mohammad F. (1998) *J. Ethnopharmacol.* 62(2): 183-193.
 245. Srinivasan D, Nathan S, Suresh T, Perumalsamy PL. (2001) *J. Ethnopharmacol.* 74: 217-220.
 246. Samy RP, Ignacimuthu S, Sen A. (1998) *J. Ethnopharmacol.* 62(2): 173-182.
 247. Naovi SAH, Khan MSY, Vohora SB. (1991) *Fitoterapia* 62(3): 221-228.
 248. Lee CK, Kim HY, Moon KH, Shin KH. (1998) *Arch. Pharm. Res.* 21(1): 62-66.
 249. Shin KH, Chi HJ, Lim SS, Cho SH, Moon HI, Yu JH. (1997) *Nat. Prod. Sci.* 3(2): 141-147.
 250. Parveen N. (1991) *Fitoterapia* 62(2): 163-165.
 251. Suresh M, Rai RK. (1990) *Curr. Sci.* 59(9): 477-479.
 252. Mishra AK, Dwivedi SK, Kishore N, Dubey NK. (1991) *Int. J. Pharmacog.* 29(4): 259-262.
 253. Rai MK. (1996) *Hindustan Antibiot. Bull.* 38 (1/4): 1-4.
 254. Avadhoot Y, Rana AC. (1991) *Arch. Pharm. Res.* 14(1): 96-98.
 255. Chaturvedi GN, Singh RH. (1965) *Indian J. Med. Res.* 53(1): 71-80.
 256. Singh RH, Chaturvedi GN. (1966) *Indian J. Med. Res.* 54: 188.
 257. Vahora SB, Khan MSY. (1981) *Indian Drugs* 16(1): 39-40
 258. Agrawal RC, Kapadia LA. (1982) *Probe.* 21(3): 201-204.
 259. Masuda T, Yonemori S, Oyama Y, Takeda Y, Tanaka T, Andoh T, Shinohara A, Nakata M. (1999) *J. Agr. Food Chem.* 47(4): 1749-1754.
 260. Basavarajaiah CR, Lucas DS, Anadarajashekhar R, Parmesh RR. (1990) *J. Res. Edu. Ind. Med.* 9(3): 25-30.
 261. Nam KW, Chang IM, Choi JS, Hwang KJ, Mar WC. (1996) *Nat. Prod. Sci.* 2(2): 130-136.
 262. Balboa JG, Lim-Sylianco CY. (1993) *Phillipp. J. Sci.* 122(1) : 1-13.
 263. Kim DH, Song MJ, Bae EA, Han Mj. (2000) *Biol. Pharm. Bull.* 23(3) : 356-358.
 264. Zheng GM, Luo ZM, Chen DM. (1999) *Guangdong Gongye Dexue Xuebao* 16(2): 41-47.
 265. Masilungan VA, Vadlamudi S, Goldin A. (1971) *Cancer Chemother. Rep.* Part- 2 2: 135-140.
 266. Mokkahasmit M, Swatdimongkol K, Satrawaha P. (1971) *Bull. Dept. Med. Sci.* 12(2/4): 36-65.
 267. Khan M, Jain DC, Bhakuni RS, Zaim M, Thakur RS. (1991) *Plant Sci.* 75: 161-165.
 268. Hattori M, Nakabayashi T, Lim YA, Miyashiro H, Kurokawa M, Shiraki K, Gupta MP, Correa M, Pilapitiya U. (1995) *Phytother. Res.* 9(4): 270-276.
 269. Bhakuni DS, Dhar ML, Dhar MM, Dhawan BN, Gupta B, Srimali RC. (1971) *Indian J. Exp. Biol.* 9: 91.
 270. Itokawa H, Watanabe K, Mihara K. (1982) *Shoyakugaku Zasshi* 36(2): 145-149.

271. Smit HF, Woerdenbag HJ, Singh RH, Meulenbeld GJ, Labadie RP, Zwaving JH. (1995) *J. Ethnopharmacol.* 47(2): 75-84.
272. Diaz F, Chavez D, Lee D, Mi Q, Chai HB, Tan GT, Kardono LBS, Riswan S, Fairchild CR, Wild R, Farnsworth NR, Cordell GA, Pezzuto JM, Kinghorn AD. (2003) *J. Nat. Prod.* 66(6): 865-867.
273. Suffness M, Abbott B, Statz DW, Wonilowicz E, Spjut R. (1988) *Phytother. Res.* 2(2): 89-97.
274. Lee EB, Lee YS. (1991) *Korean J. Pharmacog.* 22(4): 246-248.
275. Kim SY, Kim JH, Kim SK, Oh MJ, Jung MY. (1994) *J. Amer. Oil Chem. Soc.* 71 (6): 633-640.
276. Itokawa H, Mihashi S, Watanabe K, Natsumoto H, Hamanaka T. (1983) *Shoyakugaku Zasshi* 37(3): 223-228.
277. Han BH, Chi HJ, Han YN, Ryu KS. (1972) *Korean J. Pharmacog.* 4(3): 205-209.
278. Chiou GCY, Stolowich NJ, Zheng YQ, Shen ZF, Zhu M, Min ZD. (1992) *Ocular Pharmacol.* 8(2): 115-120.
279. Hebbalkar DS, Hebbalkar GD, Sharma RN, Joshi VS, Bhat VS. (1992) *Indian J. Med. Res.* 95(4): 200-203.
280. Bae EA, Han MJ, Kim NJ, Kim DH. (1998) *Biol. Pharm. Bull.* 21(9) : 990-992.
281. Abraham CC, Thomas B, Karunakaran K, Gopalakrishnan R. (1972) *Agr. Res. J. Kerala* 10: 59.
282. Tripathi AK, Rizvi SMA. (1985) *Curr. Sci.* 54(13): 630-631.
283. Vigneron JP. (1978) *Ann. Zool. Ecol. Anim.* 10: 663-694.
284. Kalyanasundaram M, Babu CJ. (1982) *Indian J. Med. Res. Suppl.* 76: 102-106.
285. Kiuchi F, Hioki M, Nakamura N, Miyashita N, Tsuda Y, Kondo K. (1989) *Shoyakugaku Zasshi* 43(4): 288-293.
286. Ali MA, Mikage M, Kiuchi F, Tsuda Y, Kondo K. (1991) *Shoyakugaku Zasshi* 45(3): 206-214.
287. Kataoka M, Takagaki Y. (1995) *Natural Med.* 49(3): 346-349.
288. Shin TY, Kim SH, Lim JP, Suh ES, Jeong HJ, Kim BD, Park EJ, Hwang WJ, Rye DG, Baek SH, An NH, Kim HM. (2000) *J. Ethnopharmacol.* 72(3): 443-450.
289. Chow SY, Chen SM, Yang CM. (1976) *J. Formosan Med. Ass.* 75: 349-357.
290. Goncalves JLS, Leitao SG, Monache FD, Miranda MMFS, Santos MGM, Romanos MTV, Wigg MD. (2001) *Phytomedicine* 8(6): 477-480.
291. Chen CP, Lin CC, Namba T. (1987) *Shoyakugaku Zasshi* 41(3): 215-225.
292. Chen CP, Lin CC, Namba T. (1989) *J. Ethnopharmacol.* 27(3): 285-295.
293. Lee BH, Choi BW, Ryu GS, Lee ES, Kang KJ, Hwang DY, Hong ND. (1997) *Korean J. Pharmacog.* 28(4): 167-173.
294. Goh SH, Soepadmo E, Chang P, Barnerjee U, Chan KC, Deverre JR, Hadi H, Loke SE, Nasrullah A, Oo SL, Taylor CE, Wong WH, Zakaria M. (1984) Proc Fifth Asian Symposium on Medicinal Plants and Spices, Seoul, Korea August 20-24 5: 473-483.
295. Shin KH, Kang SS, Kim HJ, Shin SW. (1994) *Phytomedicine* 1(2): 145-147.