International Journal of Education, Modern Management, Applied Science & Social Science (IJEMMASSS)
e-ISSN :2581-9925, Impact Factor (Cosmos: 7.555&I2OR: 5.105), Volume 08, No. 01(II), January- March, 2026, pp. 99-123

Genus *Brassica*: A Review on Phytochemical Composition and Pharmacological Properties

Pratibha Payal*

Assistant Professor, Department of Chemistry, Govt. Dungar College, Bikaner, Rajasthan, India.

*Corresponding Author: pratibha.payal111@gmail.com

Citation: Payal, P. (2026). Genus Brassica: A Review on Phytochemical Composition and Pharmacological Properties. International Journal of Education, Modern Management, Applied Science & Social Science, 08(01(II)), 99–123. https://doi.org/10.62823/IJEMMASSS/8.1(II).8704

ABSTRACT

The Brassica genus, member of the most prominent family in the plant kingdom that is rich in medicinal plants. It is indexed into condiment, vegetable, forage, and oilseed crops based on their usable plant parts such as seeds, roots, stems, buds, leaves, and inflorescences. Cruciferous vegetables are a good source of various nutritious and health- growing phytochemicals including alkaloids, brassinosteroids, glucosinolates, glycosides, poly phenolic compounds, sterols, and triterpene alcohols, vitamin C, proteins, and carbohydrates. This review provides a brief discussion on phytochemical composition and biological activities by screening the online scientific database sources and publications. Various extracts and isolated compounds of different species have been known to possess wide-ranging pharmacological applications such as antioxidant, anti-inflammatory, antimicrobial, fungicidal, anticarcinogenic, antidiabetic, hepatoprotective, anti-HIV, and acetylcholinesterase (AChE) inhibitory activity etc. The available preclinical information on these easily cultivable and edible plants strongly suggests that it could as well be a sustainable source for affordable nutraceuticals and drugs.

***Keywords**: Brassica, Medicinal Plants, Phytochemical Composition, Pharmacological Applications, Glucosinolates.*

Introduction

Brassica is the most economically important genus in the mustard family Cruciferae (Brassicaceae). It is one of the most prominent families in the plant kingdom, rich in medicinal plants. The initial term 'Cruciferae' originated due to a distinctive cross-form arrangement of petals[1]. Cruciferae comprises 3000 species grouped in 350 genera, considering essential food crops such as *Brassica, Lepidium, Nasturtium, Raphanus,* and *Crambe*[2,3] etc.

The genus *Brassica*, constitutes 150 different species is the preeminent one within the tribe Brassiceae[4]. It is indexed into condiment, vegetable, forage, and oilseed crops based on their usable plant parts such as seeds, roots, stems, buds, leaves, and inflorescences[5]. Cruciferous vegetables are a good source of various nutritious and health- growing phytochemicals[6] including alkanes, ketones, tannins, saponins, alkaloids, brassinosteroids, glucosinolates, glycosides, flavonoids, phenolic compounds, sterols, and triterpene alcohols, vitamin C, proteins, and carbohydrates. The characteristic secondary metabolite glucosinolate exhibits antibacterial, anticancer, and antifungal properties[7]. Mustard seeds are widely used as a traditional pungent spice, source of cooking oil and for treating malignant tumors in China[8]. The essential oil of *B. juncea* seeds, also referred to as mustard oil, has also been used in hair care cosmetic products[9], as an antidote in poisoning circumstances[10]. In general, the contents of these phytochemicals in seeds of above family grown in the tropical environment are higher than of those grown in temperate region[11].

Taken together, available preclinical information on this easily cultivable and edible plant strongly suggests that it could as well be a sustainable source for affordable nutraceuticals and drugs, potentially useful for the prevention and cure of diverse types of non-communicable diseases of the 21st century.

S. No.	Plant Species/ Name of Compound	Plant part/ Type of Compound	Biological Activity	Ref.
1.	***Brassica alba***			
	Sinalbin **(1)** *β*-Sitosterol	Seeds	anti-androgen and anti-inflammation activities	[12]
2.	***Brassica chinensis***			
	Myricetin **(2)** Quercetin**(3)** Kaempferol**(4)** Isorhamnetin**(5)** *α*-Carotene *β*-Carotene	Flavonols, Carotenoids		[13] [14]
	Plastochromanol-8**(6)**	Seed oil	antioxidant activity	
3.	***Brassica campestris*****(rapeseed)**			
	di-D-galactosyl-myo-inositol**(7)**	Seed meal, Carbohydrate		[14] [15]
	Plastochromanol-8	Seed oil	antioxidant activity	
4. \	***Brassica campestris*****L. ssp. *Chinensis* var. *communis***			
	Kaempferol-3-*O*-glucoside-7-*O*-glucoside, Kaempferol-3-*O*-(caffeoyl/sinapoyl/feruloyl/ coumaroyl) diglucoside-7-*O*-glucoside, Kaempferol-3-*O*-hydroxy-feruloyldiglucoside-7-*O*- glucoside, Isorhamnetin-3-*O*-glycoside-7-*O*-glycoside, Kaempferol-3-*O*-hydroxy-feruloylsophoroside-7-*O*- glucoside (Kaempferol-3-*O*-*β*-D-[2-hydroxyferuloyl-*β*- D-glucopyranosyl-(1→2)-glucopyranoside]-7-*O*-*β*-D- glucopyranoside)**(8)**	Flavonoids	antioxidant activity	[16]
	Monocaffeoylquinic acid, Caffeoylglycoside, Coumaroylquinic acid, Feruloylquinic acid, Sinapoylglycoside, Disinapoyldiglycoside, Sinapoylferuloyldiglycoside, Trisinapoyldiglycoside, Disinapoylferuloyldiglycoside	Hydroxycinnamic acid derivatives		
	Caffeoylmalate **(9)**, Hydroxyferuloylmalate**(10),** Coumaroylmalate (**11),** Feruloylmalate **(12)**, Sinapoylmalate **(13)**	Phenylpropanoids		
5.	***Brassica carinata***			
	Sinigrin**(14)**	Glucosinolate		[17]
6.	***Brassica juncea***			
	β-Sitosterol**(15),** Campesterol**(16),** 22-Dehydrocampesterol [(24S)-24-methylcholesta-5, E-22-dien-3*β*-ol], brassicasterol (24R-epimer)**(17),** 24-Methylene-25-methylcholesterol (24, 25- dimethylcholesta-5,24(28)-dien-3*β*-ol])**(18)**	Seed sterol	anticancer activity	[18]
	p-hydroxybenzyl glucosinolate**(19),** 9-(methylsulfonyl)nonyl glucosinolate**(20),** 8-(methylsulfonyl) octyl glucosinolate**(21)**	Seed glucosinolate, Methanolic		[19]
	Sinigrin	Seeds, Leaves	goitrogenic activity	[20]
	Allyl isothiocyanates, Phenyl isothiocyanates	Isothiocyanates	fungicidal, antitumor, antimicrobial and antioxidant activity	[21]
	Sinapine**(22),**Sinapic acid **(23)**(3,5-dimethoxy-4- hydroxycinnamic acid), Sinapoyl glucose,1-O-*β*-D-glucopyranosyl sinapate,	Seed acids, methanolic extract	antioxidant activity, peroxynitrite	[22]

	Vinylsyringol, p-hydroxybenzoic acid, Syringic acid, p-Coumaric acid, Ferulic acid, Protocatechuic acid, Vanillic acid, Caffeic acid, Gentisic acid, Chlorogenic acid **(24)**		scavenging activity, anxiolytic, cognition improving activity	
	Brassilexin	Elicited leaves	antifungal phytoalexin	[23]
	Cyclobranol **(25)**	Triterpene alcohol		[24]
	Se-methyl selenomethionine, (SeMMet)selenomethionine, Se-methylselenocysteine, S-(methylseleno)cysteine	shoot, root and leaves, organoselenium compounds	phytoremediation antiviral and antibacterial agents	[25]
	Isorhamnetin 3,7-di-O-*β*-D-glucopyranoside **(26),** Kaempferol 3-*O*-(2-*O*-feruloyl)- *β*-D-glucopyranosyl-(1→2)- *β*-D-glucopyranoside, 1-*O*-sinapoyl glucopyranoside **(27),** Kaempferol 7-*O*-*β*-D-glucopyranosyl-(1→3)-[*β*-D-glucopyranosyl-(1→6)]glucopyranoside**(28),** Kaempferol 3-*O*-(2-*O*-feruloyl- *β*-D-glucopyranosyl-(1→2)- *β*-D-glucopyranoside)- 7-*O*-*β*-D-glucopyranoside **(29),** Kaempferol 3-*O*- *β*-D-glucopyranosyl-(1→2)-*O*-*β*-D-glucopyranoside-7-*O*-*β*-D-glucopyranoside **(30)**	Leaves Flavonoid *n*-BuOH fraction MeOH extract	*in-vitro* and *in-vivo* antioxidant effect	[26]
	Kaempferol 3-*O*-(2-*O*-sinapoyl-*β*-D-glucopyranosyl-(1→2)- *β*-D-glucopyranoside)- 7-*O*-*β*-D-glucopyranoside **(31),** Kaempferol 3-*O*-(2-*O*-sinapoyl- *β*-D-glucopyranosyl-(1→2)- *β*-D-glucopyranoside) -7-*O*-*β*-D-glucopyranosyl-(1→6)- *β*-D-glucopyranoside **(32),** Kaempferol 3-*O*- *β*-D-glucopyranosyl-(1→2)- *β*-D-glucopyranoside) -7-*O*-*β*-D-glucopyranosyl-(1→6)- *β*-D-glucopyranoside **(33)**	Leaves flavonoids, water fraction	*in-vitro* antioxidant activity	[27] [28] [29]
	Cyclobrassinin, Spirobrassinin, Rutalexin,Indolyl-3-acetonitrile, Caulilexin (1-methoxyindolyl-3-acetonitrile), Arvelexin (4-methoxyindolyl-3-acetonitrile), N-acetyl-3- indolylmethanamine	Leaves	antifungal activity	
	Plastochromanol-8	Seed oil	antioxidant activity	
	β-Sitosterol, Linoleic acid, *α*-Linolenic acid, Trilinolenin, Lutein, *β*-Carotene	Leaves, DCM extract, Sterols, essential fatty acids, Carotenes	anticancer, protective effects against cardiovascular disorders, anti-oxidant effect, anti-inflammatory	
	Napins Juncin	Protein	antifungal, allergenicity	
7.	***Brassica napus***			
	24-methylenelanost-8-en-3*β*-ol, 4*α*,14*α*,24-trimethylcholesta-8,24-dien-3*β*-ol**(34),** 4*α*,14*α*,24-trimethyl-9*β*,19-Cyclocholest-24-en-3*β*-ol **(35)**	Seed sterols, Triterpene alcohol		[30-35]
	6-(*α*/*β*)-D-glucopyranosyl linolenate, 6-(*α*/*β*)-D-glucopyranosyl linoleate, 6-(*α*/*β*)-D-glucopyranosyl oleate, 6-(*α*/*β*)-D-glucopyranosyl palmitate, 1-(*α*/*β*)-D-glucopyranosyl palmitate, 2*α*:2*β*-D-glucopyranosyl palmitate	Fatty acid esters from pollen		
	Brassicasterol, Campesterol, Stigmasterol, Sitosterol, Avenasterol**(36)**	Phytosterols	anticancer and anti-hypertensive	
	Kaempferol 3-*O*-*β*-D- (2-sinapoyl- *β*-D-glucopyranosyl-(1→2)glucopyranoside)-7-*O*-*β*-D-glucopyranoside	Leaves, Flavonol glycoside		
	Plastochromanol-8 (PC-8)	Buds, Flower,	antioxidant	

		Pods,Seed, Leaves	activity	
	Glucobrassicanapin, Progoitrin Gluconapin	Leaves, Aliphatic glucosinolates		
	(-)-Epicatechin, Kaempferol-sinapoyl-trihexoside, Quercetin-3-*O*-glucoside, Quercetin-dihexoside, Isorhamnetin-3-*O*-glucoside, Isorhamnetin-dihexoside, Isorhamnetin-hexosidesulfate, Isorhamnetin-sinapoyl-trihexoside	Seed coat Flavonoids		
	Sinapoylglucose, 1-*O*-E-caffeoyl-*β*-gentiobiose **(37),** 1-*O*-E-(5-hydroxyferuloyl)- *β*-glucopyranose **(38),** Kaempferol 3-O-sophoroside-7-O- *β*-glucopyranoside **(30),** Kaempferol 3-*O*-(2″-*O*-E-sinapoylsophoroside) -7-*O*-*β*-D-glucopyranoside **(31),** Kaempferol 4′-*O*-(6-*O*-E-sinapoyl *β*-glucopyranoside)-3,7-di-*O*-*β*-D-glucopyranoside **(39),** Spermidine conjugate **(40),** Kaempferol 3-O-sophoroside-7-O-(2-*O*-E-sinapoyl *β*-glucopyranoside) **(41),** 1,2-Di-*O*-E-sinapoyl-*β*-gentibiose **(42),** 1,2-Di-*O*-E-sinapoyl-*β*-glucopyranose **(43),** 1,2,2′-Tri-*O*-E-sinapoyl-*β*-gentibiose **(44),** 1,6-Di-*O*-E-sinapoyl-*β*-glucopyranose **(45),** 1,2,6′-Tri-*O*-E-sinapoyl-*β*-gentibiose **(46)**	Seeds, Methaolic extract Gentiobiose esters, Glucose esters, Kaempferol sinapoylglucosides an unusual cyclic spermidine amide		
8.	***Brassica nigra***			
	Myricetin, Fisetin, Morin, Quercetin Kaempferol, Isorhamnetin	Flavonols		[12]
	Sinigrin, Sinapic acid, Sinapine	acids		
9.	***Brassica oleracea* var. *acephala***			
	1-Sinapoylgentiobioside, Sinapoylcholine, Kaempferol-3-*O*-(sinapoyl)-diglucoside-7-*O*-glucoside, Kaempferol-3-*O*-(sinapoyl)-triglucoside-7-*O*-glucoside, Kaempferol-3-*O*-triglucoside-7-*O*-glucoside, Kaempferol-3-*O*-diglucoside-7-*O*-glucoside, 1,2-Disinapoylglucoside, 1,2-Disinapoylgentiobioside, 1,2,2′-Trisinapoylgentiobioside, Quercetin-3-*O*-diglucoside-7-*O*-glucoside, Isorhamnetin-3-*O*-diglucoside-7-*O*-glucoside	Seed phenolics	acetylcholinesterase (AChE) inhibitory activity *in vitro*	[36-37]
	4-methylsulfinylbutyl Isothiocyanate	Sulforaphane	anticancer	
	Quercetin-3-*O*-sophoroside, Quercetin-3-*O*-sophoroside-7-*O*-glucoside, Quercetin-3-*O*-(sinapoyl/feruloyl)sophoroside-7-*O*-glucoside, Quercetin-3-*O*-(feruloyl) sophoroside-7-*O*-diglucoside, Quercetin-3-*O*-(sinapoyl/feruloyl) sophoroside, Quercetin-3-*O*-sophoroside-7-*O*-diglucoside, Quercetin-3-*O*-sophorotrioside-7-*O*-glucoside, Quercetin-3-*O*-sophorotrioside-7-*O*-diglucoside, Kaempferol-3-*O*-sophoroside, Kaempferol-3-*O*-(sinapoyl/feruloyl) sophoroside,Kaempferol-3-*O*-sophoroside-7-*O*-glucoside,Kaempferol-3-*O*-sophorotrioside-7-*O*-glucoside,Kaempferol-3-*O*-(methoxy caffeoyl/ caffeoyl) sophoroside-7-*O*-glucoside, Kaempferol-3-*O*-(sinapoyl/feruloyl/p-coumaroyl) sophoroside-7-*O*-glucoside, Kaempferol-3-*O*-(sinapoyl/feruloyl/p-coumaroyl) sophoroside-7-*O*-diglucoside, Kaempferol-3-*O*-gentiobioside-7-*O*-	Leaves, Aqueous extract Flavonoid and Acylated flavonoid glycosides	anti-oxidant activity	

	glucoside, Kaempferol-3-*O*-gentiobioside-7-*O*-diglucoside,Kaempferol-3-*O*-(p-coumaroyl)gentiobioside-7-*O*-glucoside, Isorhamnetin-3-*O*-sophoroside-7-*O*-glucoside,Isorhamnetin-3-*O*-sophoroside-7-*O*-diglucoside, Isorhamnetin-3-*O*-gentiobioside-7-*O*-glucoside, Disinapoyl-gentiobioside, Diferuloyl-gentiobioside, Sinapoyl, Feruloyl-gentibioside, Disinapoyl, feruloyl-gentiobioside			
	Kaempferol-3-(2-(sinapoyl/feruloyl) glucopiranosyl(1,2) glucopiranoside)-7-(glucopiranosyl(1,4)glucopiranoside)	flavonoid glycosides		
10	***Brassica oleracea* L. var. *botrytis***			
	1,2-Disinapoyl-diglucoside, 1-Sinapoyl-2-feruloyl-diglucoside, 1,2,2′-Trisinapoyl-diglucoside, Sinapic acid, 1,2′-Disinapoyl-feruloyl-diglucoside	Methanolic extract, Sinapic acid derivatives		[38-44]
	Glucoalyssin, glucoiberverin, glucobrassicin Neoglucobrassicin, 4-hydroxygluco brassicin 4-methoxygluco brassicin	Glucosinolates		
	Quercetin-7-*O*-diglucoside, Quercetin-3-*O*-diglucoside-7-*O*-glucoside, Quercetin-3-*O*-coumaroyl glucoside-7-*O*-hydroxyferuloylglucoside, Kaemoferol-3-*O*-glucoside, Kaemoferol-3-*O*-diglucoside, Kaemoferol-3-*O*-triglucoside, Kaemoferol-3-*O*-diglucoside-7-*O*-diglucoside,Kaemoferol-3-*O*-diglucoside-7-*O*-(hydroxyferuloyl/ feruloyl)glucoside,Kaemoferol-3-*O*-coumaroyldiglucoside-7-*O*-(hydroxyferuloyl)glucoside, Kaemoferol-3-*O*-(coumaroyl/feruloyl/sinapoyl)diglucoside-7-*O*-glucoside, Kaemoferol-3-*O*-feruloyldiglucoside-7-*O*-diglucoside, Kaempferol-3-*O*-(sinapoyl/coumaroyl/feruloyl)diglucoside	Leaves, MeOH extract, Flavonoid glycosides	anti-oxidant activity, angiotensinconverting enzyme inhibitory activity, anti-obesity activity	
	Kaempferol-O, C-tetraglucoside, Kaempferol-O, C-pentaglucoside, Kaempferol-O, C-hexaglucoside, Kaempferol-O, C-hydroxy feruloyltetraglucoside, Kaempferol-O, C-feruloylpentaglucoside	Putative C glycosides		
	Kaempferol, Quercetin	Aglycones		
	Sinapic acid, Ferulic acid	Phenolic acids		
	Isalexin, S-(-)-Spirobrassinin, 1-Methoxybrassitin, Brassicanal C, Caulilexins A,Caulilexins B, Caulilexins C	Florets	phytoalexin, antifungal activity	
	Se-Methylselenocysteine	Organoselenium compounds	Phytoremediation,antiviral, antibacterial agents	
	4-methylsulfinylbutyl Isothiocyanate (Sulforaphane)	Seed	anticancer effect	
	Kaempferol7-glucoside, Kaempferol 7-diglucoside,Kaempferol 3-triglucoside-7-glucoside,Kaempferol 3-sinapoyltriglucoside-7-glucoside, Kaempferol 3-sinapoyltriglucoside-7-diglucoside,Kaempferol 3-caffeoyldiglucoside-7-	Leaves, Aqueous extract		

	glucoside, Kaempferol 3-glucoside-7-glucoside, Kaempferol 3-sinapoyltriglucoside, Kaempferol 3-sinapoyldiglucoside, Kaempferol 3-disinapoyltriglucoside-7-diglucoside, Kaempferol 3-disinapoyltriglucoside-7-glucoside			
	Cyanidin-3-glucoside **(47)**, Cyanidin-3-glucoside-5-glucoside**(48)**, Cyanidin 3-sophoroside-5-glucoside **(49)**, Cyanidin 3-(6-p-coumaryl) sophoroside-5-glucoside **(50),** Cyanidin 3-(6-feruloyl) sophoroside-5-glucoside**(51)**, Cyanidin 3-(6-sinapyl) sophoroside-5-glucoside **(52)**, Cyanidin 3-(6-p-coumaryl) sophoroside-5-(6-sinapyl)-glucoside **(53),**Cyanidin 3-(6-feruloyl) sophoroside-5-(6-sinapyl)-glucoside **(54),** Cyanidin 3-(6-sinapyl)-sophoroside-5-(6-sinapyl)-glucoside **(55)**	Floret, Anthocyanins		
11.	***Brassica oleracea L.* var *capitata***			
	Rutin, Kaempferol 3-sophoroside-7-glucoside (Kaempferol 3-*O*-*β*-D-glucopyranosyl (1→2)-*β*-D-glucopyranoside-7- *β*-D-glucopyranoside), Kaempferol 3-*O*-*β*-D-(2-E-sinapoyl-*β*-D-glucopyranosyl (1→2)glucopyranoside)-7-*O*- *β*-D-glucopyranoside, Kaempferol 3-*O*-*β*-D-(2-E-feruloyl-*β*-D-glucopyranosyl (1→2) glucopyranoside)-7-*O*- *β*-D-glucopyranoside, Kaempferol 3-*O*-*β*-D-(2-E-p-coumaroyl- *β*-D-glucopyranosyl (1→2) glucopyranoside)-7-*O*- *β*-D-glucopyranoside **(56)**, Kaempferol 3-*O*-*β*-D-(2-E-caffeoyl-*β*-D-glucopyranosyl (1→2) glucopyranoside)-7-*O*- *β*-D-glucopyranoside **(57),** Quercetin 3-*O*-*β*-D-(2-E-feruloyl- *β*-D-glucopyranosyl (1→2) glucopyranoside)-7-*O*- *β*-D-glucopyranoside **(58)**, Quercetin 3-*O*-*β*-D-(2-E-caffeoyl- *β*-D-glucopyranosyl (1→2) glucopyranoside)-7-*O*- *β*-D-glucopyranoside **(59)**	Leaf Flavonoid, Acylated flavonol glycoside	antioxidant activity	[42][45-49]
	Selenocystathionine, Se-methylselenocysteine, Selenomethionine,Se-Methylselenocysteine Se-oxide	Organoselenium compounds	Phytoremediation,antiviral, antibacterial agents	
	Glucoiberin, Progoitrin, Epiprogoitrin, Sinigrin, Glucorafanin, Gluconapoleiferin Glucoalisin, Gluconapin, Glucobrassicin, 4-Hydroxybrassicin Glucobrassicanapin, Gluconasturcin ,4-Metoxyglucobrassicin Neoglucobrassicin	Glucosinolates	anticarcinogenic properties, antioxidant activity	
	Cyanidin 3-diglucoside, Cyanidin 3,5-diglucoside Cyanidin 3-(sinapoyl) glucoside-5-glucoside, Cyanidin 3-diglucoside-5-glucoside, Cyanidin 3-(sinapoyl/ feruloyl/ caffeoyl/ glycopyranosyl-sinapoyl)-diglucoside-5-glucoside, Cyanidin 3-(caffeoyl) (p-coumaroyl)-diglucoside-5-glucoside, Cyanidin 3-(sinapoyl) (p-coumaroyl)-diglucoside-5-glucoside, Cyanidin 3-(sinapoyl) (sinapoyl)-diglucoside-5-glucoside, Cyanidin 3-(feruloyl) (sinapoyl)-diglucoside-5-glucoside, Cyanidin 3-(malonoyl) (p-hydroxybenzoyl) triglucoside -5-glucoside, Cyanidin 3-(sinapoyl) (p-coumaroyl)-triglucoside-5-glucoside, Cyanidin 3-(feruloyl) (sinapoyl)-triglucoside-5-glucoside, Cyanidin 3-(sinapoyl) (sinapoyl)-triglucoside-5-glucoside, Cyanidin 3-diglucoside-5-xyloside, Cyanidin 3-(sinapoyl) diglucoside-5-xyloside,	Anthocyanins	neurodegenerative declines, cancer protection and suppression, improve cardiovascular health, stimulate insulin secretion, and ameliorate oxidative stress	

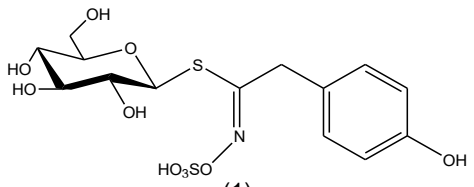
	Peonidin 3,5-diglucoside, Peonidin 3-diglucoside-5-glucoside			
12.	***Brassica oleracea* var. *costata***			
	1-Sinapoylgentiobioside, Sinapoylcholine, 1-Sinapoylglucoside, 1,2-Disinapoylglucoside, 1,2-Disinapoylgentiobioside, 1,2,2′-Trisinapoylgentiobioside, Kaempferol 3-*O*-(sinapoyl) diglucoside-7- *O*-glucoside, Kaempferol 3-*O*-(sinapoyl) triglucoside-7-*O*-glucoside, Kaempferol 3-(sinapoyl) sophorotrioside-7-glucoside, Kaempferol 3,7-diglucoside-4′-(sinapoyl) glucoside	Seed phenolics, aqueous extract Leaves phenolics	acetylcholinesterase (AChE) inhibitory activity	[50-51]
	Oxalic acid, Pyruvic acid, Quinic acid, Malic acid, Shikimic acid, Citric acid, Aconitic acid, Fumaric acid	Seed and internal leaves organic acids	Antioxidant activity	
	Kaempferol 3-*O*-sophoroside-7-*O*-glucoside, Kaempferol 3-*O*-sophorotrioside-7-*O*-glucoside**(60),** Kaempferol 3-*O*-(caffeoyl/ sinapoyl) sophoroside-7-*O*-glucoside, Kaempferol 3-*O*-(caffeoyl/ methoxy caffeoyl) sophoroside-7-*O*-glucoside**(61),** Kaempferol 3-*O*-sophorotrioside-7-*O*-sophoroside**(62),**Kaempferol 3-*O*-sophoroside-7-*O*-sophoroside**(63),**Kaempferol 3-*O*-tetraglucoside-7-*O*-sophoroside**(64),** Kaempferol 3-*O*-(feruloyl/caffeoyl)sophoroside-7-*O*-glucoside**(65),** Kaempferol 3-*O*-sophorotrioside **(66),** Kaempferol 3-*O*-(sinapoyl) sophoroside **(67),** Kaempferol 3-*O*-(feruloyl) sophorotrioside **(68),** Kaempferol 3-*O*-(feruloyl) sophoroside **(69),** Kaempferol 3-*O*-sophoroside **(70),** Kaempferol 3-*O*-glucoside**(71),** 1,2′-Disinapoyl-2-feruloylgentiobiose, Sinapoyl-2-feruloylgentiobiose	Leaves Phenolics		
	3-(caffeoyl/ p-coumaroyl/ feruloyl) quinic acid, 4-(caffeoyl/ p-coumaroyl) quinic acid, caffeoyl, feruloylquinic acid, Kaempferol 3-*O*-sophoroside, Kaempferol 3-*O* -(feruloyl/ caffeoyl/ methoxycaffeoyl) sophorotrioside, Kaempferol 3-*O*-(methoxycaffeoyl/ sinapoyl/ caffeoyl) sophorotrioside-7-*O*-sophoroside, Kaempferol 3-*O*-(caffeoyl/sinapoyl/ feruloyl/ methoxycaffeoyl/ disinapoyl) sophorotrioside-7-*O*-glucoside, Kaempferol 3-*O*-(feruloyl/sinapoyl) sophorotrioside-7-*O*-rhamnoside,Quercetin 3-*O*- sophoroside, Quercetin 3-*O*-(sinapoyl) sophorotrioside, Quercetin 3-*O*-(sinapoyl/ disinapoyl) sophorotrioside-7-*O*-glucoside, sinapoyl, feruloyl, caffeoyl-gentiobioside, Methoxycaffeoyl-gentiobioside, Disinapoyl, methoxycaffeoyl-gentiobioside, Disinapoyl, caffeoyl-gentiobioside, 1-Sinapoyl, 2-feruloyl-gentiobioside, Diferuloyl, sinapoyl -gentiobioside 1,2,2′-Trisinapoyl-gentiobioside, 1,2′-Disinapoyl, 2-feruloyl-gentiobioside,	Shoots	antioxidant activity	
13	***Brassica oleracea* spp *italic***			
	Glucoiberin, Progoitrin, Sinigrin, Glucoraphanin, Gluconapin, 4-Hydroxyglucobrassicin, Glucoiberverin, Glucoerucin, 4-Methoxyglucobrassicin	Seed glucosiolates		[52-53]
	1,2-Disinapoyldiglucoside, 1-Sinapoyl-2-feruloyldiglucoside, 1,2,2′-Trisinapoyldiglucoside, 1,2′-Disinapoyl-2-feruloyldiglucoside	Floret phenolics	antimicroial, antioxidant activity	
	Z-4-(methylsulfinyl)-N-(sulfoxy)-2((2′S, 3′R, 4′S, 5′S,	Floret		

	6′R)-2′-mercaptotetrahydro-3′,4′,5′-trihydroxy-6′(hydroxymethyl)-2H-pyran-2-yl) butanimidic acid **(72),** Z-1-((2S, 5S)-5-hydroxytetrahydro-2H-pyran-2-ylthio-2-(1H-indol-3-yl) ethylidene aminosulphate **(73),** Cinnamoyl (6′-*O*-trans-(4″-hydroxycinnamoyl)-4-(methylsulfinyl) butyl glucosinolate) **(74)**	glucosinolates		
	3-Butenyl isothiocyanate, Sulforaphane, 2-Methyl-2-nitropropane, Butyronitrile, 1,4-diformyloxy-2-isocyanobutane, 3-Methyl-1-(methylsulfinyl)butane	Seeds, Sprouts, Floret and Leaves	anticancer, free radical scavenging, antiproliferative activities	
14	***Brassica oleracea* var *oleracea***			
	Sinapoylcholine, Kaempferol 3-*O*-sophoroside-7-*O*-*β*-glucopyranoside, 1,6-Di-*O*-sinapoylglucose, 1,2-Di-*O*-E-sinapoyl-*β*-glucopyranose, 1,2-Di-*O*-E-sinapoyl-*β*-gentiobiose, 1,2,2′-Tri-*O*-E-sinapoyl-*β*-gentiobiose, Spermidine conjugate	Seed		[57]
16	***Brassica oleracea* var. *sabellica***			
	Chlorogenic acid, Kaempferol 3-*O*-(sinapoyl) sophoroside-7-*O*-glucoside, Kaempferol 3-*O*-(feruloyl) sophoroside-7-*O*-glucoside, Kaempferol3-*O*-(hydroxylferuloyl) sophoroside-7-*O*-glucoside [Kaempferol 3-*O*-*β*-D-(2-E-hydroxylferuloyl-*β*-D-glucopyranosyl-(1→2) glucopyranoside)-7-*O*-*β*-glucopyranoside] **(75),**	Leaves	antioxidant activity	[54-55]
	Quercetin 3-*O*-(sinapoyl) sophoroside-7-O-glucoside [Quercetin 3-*O*-*β*-D-(2-E-sinapoyl-*β*-D-glucopyranosyl-(1→2) glucopyranoside)-7-*O*-*β*-glucopyranoside] **(76),** Kaempferol 3-*O*-(sinapoyl) sophoroside-7-*O*-diglucoside [Kaempferol 3-*O*-*β*-D-(2-E-sinapoyl-*β*-D-glucopyranosyl-(1→2) glucopyranoside)-7-*O*-*β*-D-glucopyranosyl-(1→4)-glucopyranoside] **(77),** Kaempferol 3-*O*-(feruloyl) sophoroside-7-*O*-diglucoside **(78)**, Kaempferol 3-*O*-(disinapoyl) triglucoside-7-*O*-glucoside **(79)**, 1,2-Disinapoyl-gentiobioside **(80)** (6-*O*-*β*-D-glucopyranosyl- *β*-D-(1,2-di-*O*-sinapoyl) glucopyranose), 1-Sinapoyl, 2-feruloyl-gentiobioside **(81)**(6-*O*-*β*-D-glucopyranosyl- *β*-D-(1-*O*-sinapoyl, 2- *O*-feruloyl) glucopyranose)			
	Quercetin-7-*O*-glucoside, Isorhamnetin/ Kaempferol/ Quercetin-3-*O*-glucoside, Isorhamnetin/ Kaempferol/ Quercetin-3-*O*-sophoroside, Isorhamnetin/ Kaempferol/ Quercetin-3-*O*-gentiobioside, Isorhamnetin/ Kaempferol/ Quercetin-3-*O*-glucoside-7-*O*-glucoside	Flavonol mono- and diglycosides		
	Isorhamnetin/ Quercetin/ Kaempferol-3-*O*-triglucoside, Isorhamnetin/ Quercetin/ Kaempferol-3,4′,7-*O*-triglucoside, Isorhamnetin/ Quercetin/ Kaempferol-3-*O*-sophoroside-7-*O*-glucoside, Isorhamnetin-3-gentiobioside-7-*O*-glucoside	Flavonol triglycosides		
	Isorhamnetin/ Quercetin/ Kaempferol-3-*O*-	Flavonol		

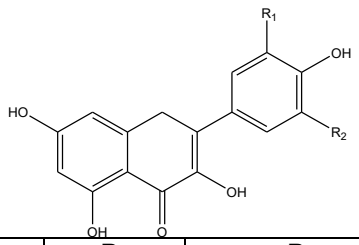
	sophoroside-7-*O*-diglucoside	tetraglycosides		
	Quercetin-3-*O*- (sinapoyl/ feruloyl/ caffeoyl/ hydroxyferuloyl) sophoroside, Kaempferol-3-*O*- (sinapoyl/ feruloyl/ coumaroyl/ caffeoyl/ hydroxyferuloyl) sophoroside	Monoacylated flavonol diglycosides		
	Kaempferol/ Quercetin 3-*O*-coumaroyl-sophoroside-7-*O*-glucoside, Kaempferol/ Quercetin 3-*O*-(feruloyl/ hydroxyferuloyl)-sophoroside-7-*O*-glucoside, Kaempferol/ Quercetin 3-*O*-(caffeoyl/ sinapoyl)-sophoroside-7-*O*-glucoside, Isorhamnetin 3-*O*-(sinapoyl)-sophoroside-7-*O*-glucoside	Monoacylated flavonol triglycosides		
	Kaempferol 3-*O*-(feruloyl/ hydroxyferuloyl)-sophoroside-7-*O*-diglucoside, Kaempferol 3-*O*-(sinapoyl/ caffeoyl)-sophoroside-7-*O*-diglucoside, Quercetin 3-*O*-sophoroside-7-*O*-(sinapoyl/ feruloyl)-diglucoside, Isorhamnetin 3-*O*-(feruloyl)-sophoroside-7-*O*-diglucoside	Monoacylated flavonol tetraglycosides		
	Kaempferol/ Quercetin 3-*O*-(disinapoyl)-triglucoside-7-*O*-D-glucoside, Kaempferol/ Quercetin 3-*O*-(sinapoyl, feruloyl)-triglucoside-7-*O*-D-glucoside, Kaempferol/ Quercetin 3-*O*-(sinapoyl)-diglucoside-7-*O*-D-diglucoside	Diacylated flavonol tetraglycosides		
	Kaempferol 3-*O*-(disinapoyl)/(diferuloyl)/ (sinapoyl, feruloyl)-triglucoside-7-*O*-D-diglucoside, Quercetin 3-*O*-(sinapoyl, feruloyl)-triglucoside-7-*O*-D-diglucoside, Quercetin 3-*O*-(sinapoyl)-triglucoside-7-*O*-(sinapoyl)-diglucoside, Isorhamnetin 3-*O*-(disinapoyl)-triglucoside-7-*O*-D-diglucoside	Diacylated flavonol pentaglycosides		
17	***Brassica rapa***			
	Gluconapin, Glucobrassicanapin Progoitrin, Epiprogoitrin, Glucoiberin Glucoiberverin, Glucoraphanin Glucoalyssin, Gluconapoleiferin Glucoerucin, Glucobrassicin Neoglucobrassicin, 4-Hydroxyglucobrassicin, 4-Methoxyglucobrassicin, Gluconasturtiin, Dihydrogluconapin, Glucotropaeolin	Leaves, Flower Buds, Seeds, Turnip tops and greens glucosinolates	goitrogenic *in vivo*, chemoprotective, anti-proliferative, apoptosis of cancer cells, antioxidant, antimicrobial activity	[56-59]
	Sinapoyl/ caffeoyl/ coumaroyl malate, Feruloyl/ 5-hydroxyferuloyl malate	Leaves, methanolic-water extract, Phenyl propanoids		
	Kaempferol/ Quercetin/ Isorhamnetin-7-*O*-glucoside, Kaempferol/ Quercetin/ Isorhamnetin-3,7-di-*O*-glucoside, Kaempferol/ Quercetin-3-*O*-sophoroside, Kaempferol/ Quercetin-3-*O*-sophoroside-7-*O*-glucoside, Kaempferol-3-*O*-triglucoside-7-*O*-glucoside	Turnip greens, Turnip tops, Leaves Deacylated flavonoids		
	Quercetin 3-*O*-(feruloyl) sophoroside, Kaempferol 3-*O*-(sinapoyl/ caffeoyl/methoxycaffeoyl) sophoroside, Kaempferol/ Quercetin 3-*O*-(caffeoyl/	Acylated flavonoids		

	methoxycaffeoyl) sophoroside-7-*O*-glucoside, Kaempferol/Quercetin 3-*O*-(sinapoyl/ feruloyl) sophoroside-7-*O*-glucoside, Kaempferol/ Quercetin 3-*O*-(p-coumaroyl) sophoroside-7-*O*-glucoside			
	Caffeic acid, Sinapic acid, Sinapoylglucoside, 1,2-disinapoylgentiobioside, 1-sinapoyl, 2-feruloylgentiobioside, 1,2,2′-trisinapoylgentiobioside, 1,2′-disinapoyl, 2-feruloyl-gentiobioside,3-caffeoyl/ 3-p-coumaroyl quininic acid	Hydroxycinnamic acids		
	Isorhamnetin 3,7-di-*O*-*β*-D-glucopyranoside	Flower, Flavonoid	nectar guide for attracting pollinating insects	
	Sinapine, Sinapoylmalate, 1,6 Di-*O*-sinapoylglucose, 1,2 Di-*O*-E-sinapoyl-*β*-glucopyranose, 1,6 Di-*O*-E-sinapoyl-*β*-glucopyranose, 1,2 Di-*O*-E-sinapoyl-*β*-gentiobiose, 1,2,2′ Tri-*O*-E-sinapoyl-*β*-gentiobiose, 1,2,6′ Tri-*O*-E-sinapoyl-*β*-gentiobiose, Kaempferol 3-(2″-O-E-sinapoylsophoroside)-7-*O*-*β*-D-glucopyranoside, Kaempferol 3-*O*-sophoroside-7-*O*-(2-O-E-sinapoyl) -*β*-D-glucopyranoside,	Seeds		
	Spirobrassinin **(82)**, Cyclobrassinin **(83),** Rutalexin **(84),** Rapalexin A **(85),** Rapalexin B **(86),** Brassinin **(87),** Brassilexin **(88),** Brassicanal C **(89)**	Leaves Phytoalexins	anti-oomycete activity	
	Indolyl-3-acetonitrile **(90),** Caulilexin C **(91),** Arvelexin **(92),**Indole-3-carboxaldehyde**(93)**	Phytoanticipins		
	Caffeoylmalate, 5-Hydroxy-feruloylmalate**,** Coumaroylmalate**,** Feruloylmalate, Sinapoylmalate, Dimethyl feruloyl malate **(94),** Dimethyl sinapoyl malate **(95)**, Methyl feruloyl malate **(96)**, Methyl sinapoyl malate **(97)**, Methyl feruloyl malate **(98)**, Methyl sinapoyl malate **(99)**, Coniferin	Phenylpropanoid malates		
	Kaempferol 3-*O*-*β*-D-(2E-5-hydroxyferuloyl- *β*-D-glucopyranosyl (1→2)-glucopyranoside)-7-*O*- *β*-D-glucopyranoside,Quercetin 3-*O*-*β*-D-(2E-5-hydroxyferuloyl- *β*-D-glucopyranosyl (1→2)-glucopyranoside)-7-*O*- *β*-D-glucopyranoside	Flavonoids		
	Roseoside **(100),**Citroside A **(101)**	Ionones		
	L-Tryptophan **(102),** L-Phenylalanine **(103),**L-Tyrosine**(104),**	Amino acid		
	Adenosine **(105),** Cytidine **(106),** Uridine **(107)**	Nucleotides		
	4-methylsulfinylbutylIsothiocyanate (Sulforaphane)	Seed	Anticancer effect	
18.	***Brassica rapa* L. *hidabeni***			
	4′-*O*-*β*-D-glucopyranosyl-4-hydroxy-3′-methoxychalcone **(108),** 4′-*O*-*β*-D-glucopyranosyl-3′,4-dimethoxychalcone **(109),** 4,4′-di-*O*-*β*-D-glucopyranosyl-3′-dimethoxy chalcone **(110),** Picein **(111),**Glucoacetosyringone **(112),** Corchoionoside **(113)**	Aerial part, Methanol, Chalcone glycosides		[60]
19.	***Brassica rapa* ssp. *Campestris***			
	2,6,3′,4′-Tetraisovalerate**(114),** Sucrose3,3′,4′-triisovalerate**(115),** Sucrose 6,3′,4′-triisovalerate**(116),**	Root, Carbohydrate derivatives	enzyme-activated irreversible	[61-62]

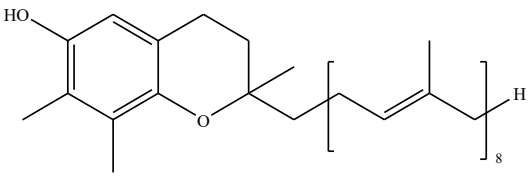
	Ethyl *β*-D-glucopyranoside**(117),** *n*-butyl-*β*-D-fructofuranoside**(118),** Ethanone-1-C-*β*-D-glucopyranoside (3,7-anhydro-1-deoxy-D-glycero-D-gulo-2-octulose**(119),** *n*-pentyl *β*-D-fructofuranoside**(120),**	EtOAc, *n*-BuOH fractions	inhibitors, modulatorof inflammatory states, skin barrier, hepatoprotectiv e agent,antiHIV, anti diabetes, and anticancer.	
20	***Brassica rapa* ssp. *Chinensis***			
	Glucoerucin, Glucoraphanin, Glucoalyssin, Gluconapin, Glucobrassicanapin, Progoitrin, Gluconapoleiferin, Gluconasturttin, Glucobrassicin, 4-Hydroxy- Glucobrassicin, 4-Methoxy- Glucobrassicin, Neoglucobrassicin	Glucosinolates,	anticarcinogeni c, cholesterol-reducing	[63]
	Kaempferol Isorhamnetin	Leaves, flavonoids	antioxidant	
21	***Brassica tournefortii***			
	Kaempferol, Quercetin, Kaempferol/Quercetin 3-*O*-*β*-D-glucopyranoside, Kaempferol 7-*O*-*α*-L-rhamnopyranoside, Kaempferol 3-*O*-*β*-arabinopyranoside-7-*O*-*α*-L-rhamnoside, Robinin (Kaempferol 3-*O*-(6″- *α*-L-rhamnopyranosyl)-*β*-D-galactopyranoside-7- *O*-*α*-L-rhamnopyranoside), Quercetin 3-*O*-(6″- *α*-L-rhamnopyranosyl)- *β*-D-glucopyranoside, Quercetin 3-*O*-(6″- *α*-L-rhamnopyranosyl)- *β*-D-galactopyranoside-7- *O*-*α*-L-rhamnopyranoside	Whole plant, MeOH extract, Flavonoids		[64]



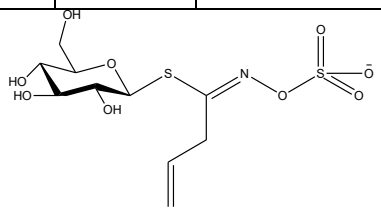
(1)



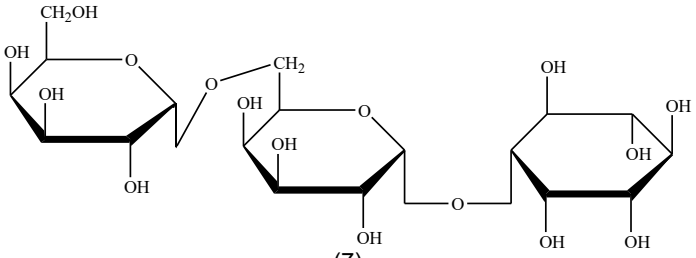
	R_1	R_2
2	OH	OH
3	H	OH
4	H	H
5	OCH_3	H



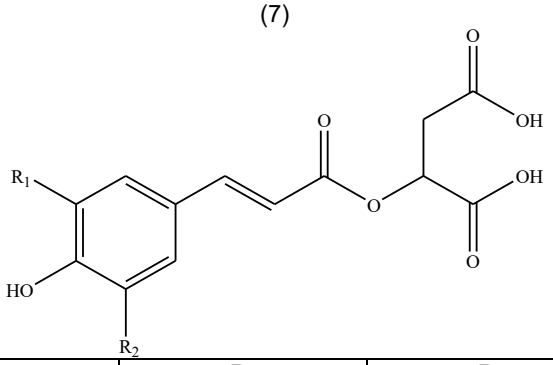
(6)



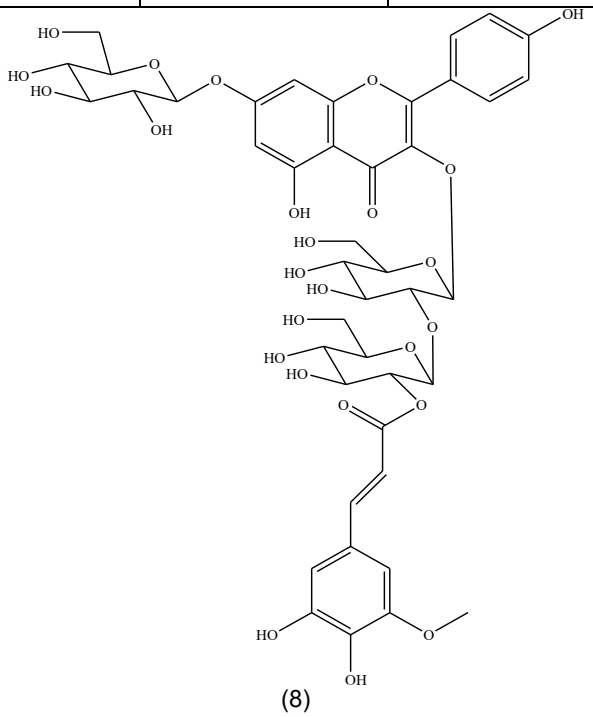
(14)



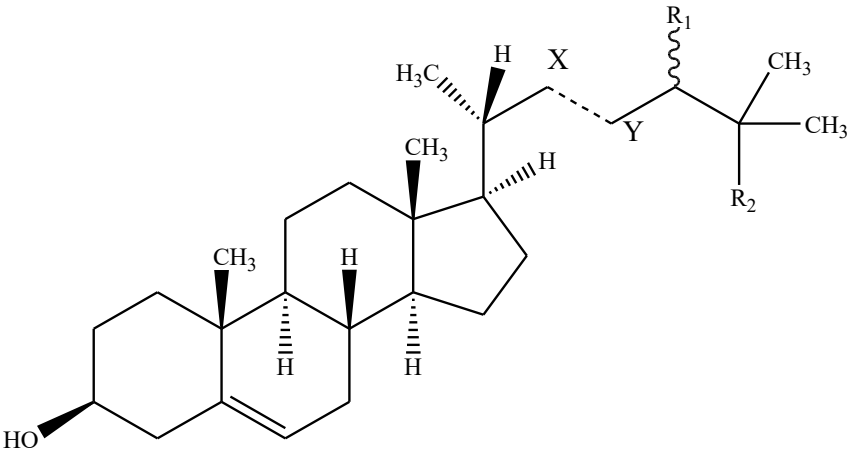
(7)



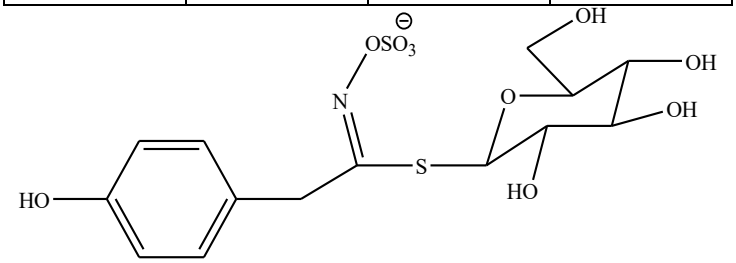
	R_1	R_2
9	OH	H
10	OCH_3	OH
11	H	H
12	OCH_3	H
13	OCH_3	OCH_3



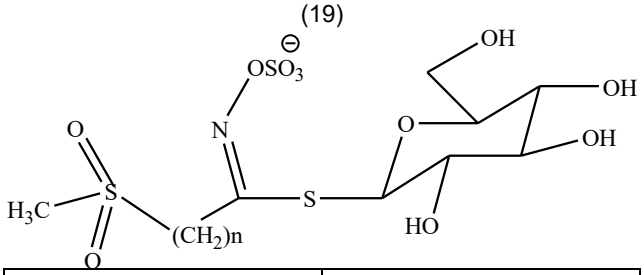
(8)



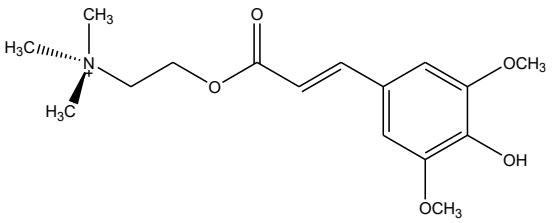
	X--Y	R_1	R_2
15	X–Y	*β*-Et	H
16	X–Y	*β*-Me	H
17	X=Y	*α*-Me	H
18	X–Y	=CH_2	Me
36	X–Y	=CHMe	H



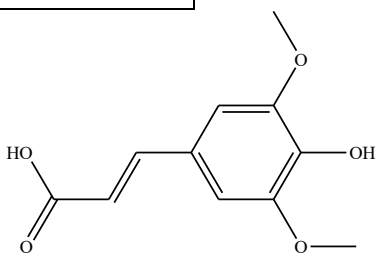
(19)



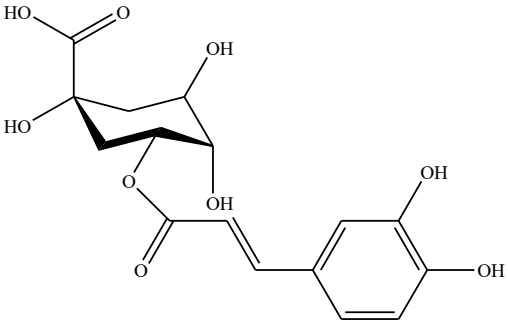
	n
20	9
21	8



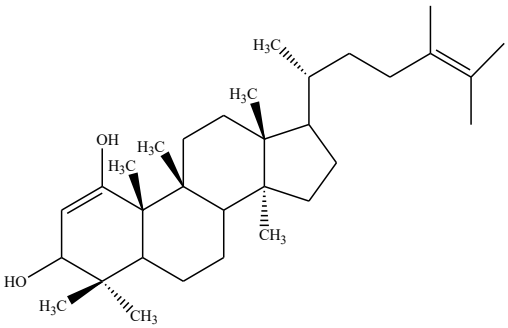
(22)



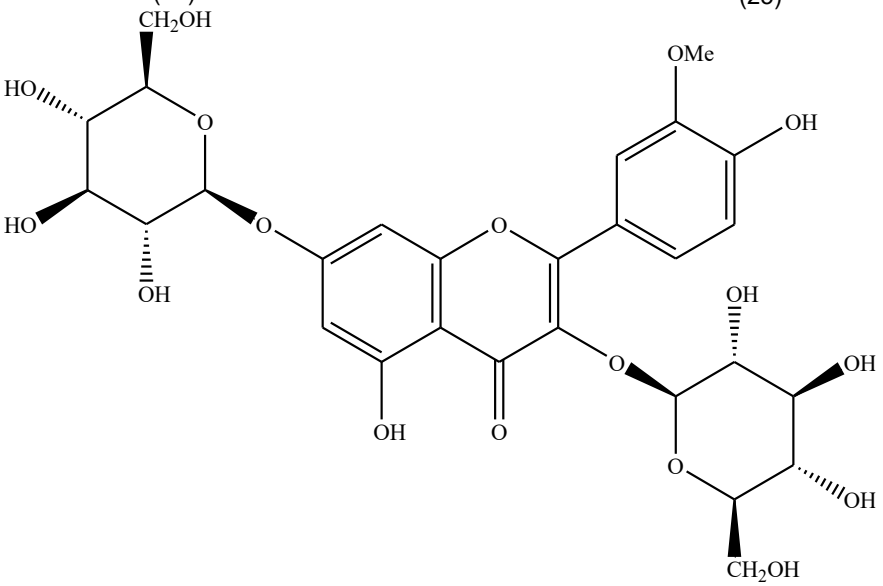
(23)



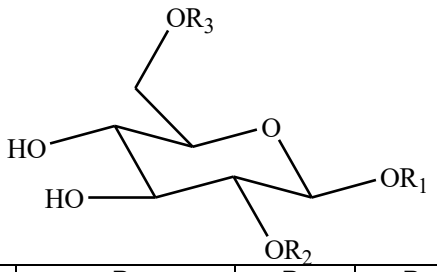
(24)



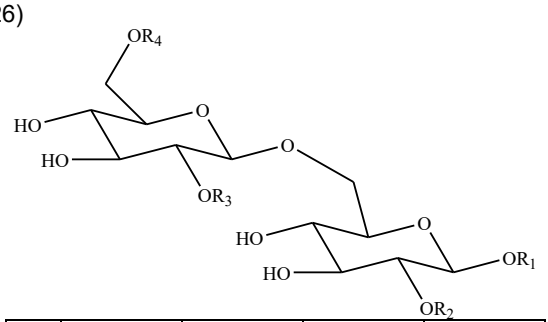
(25)



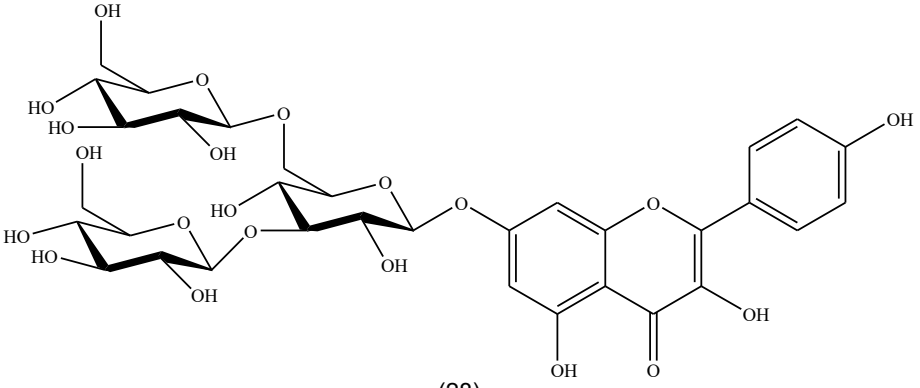
(26)



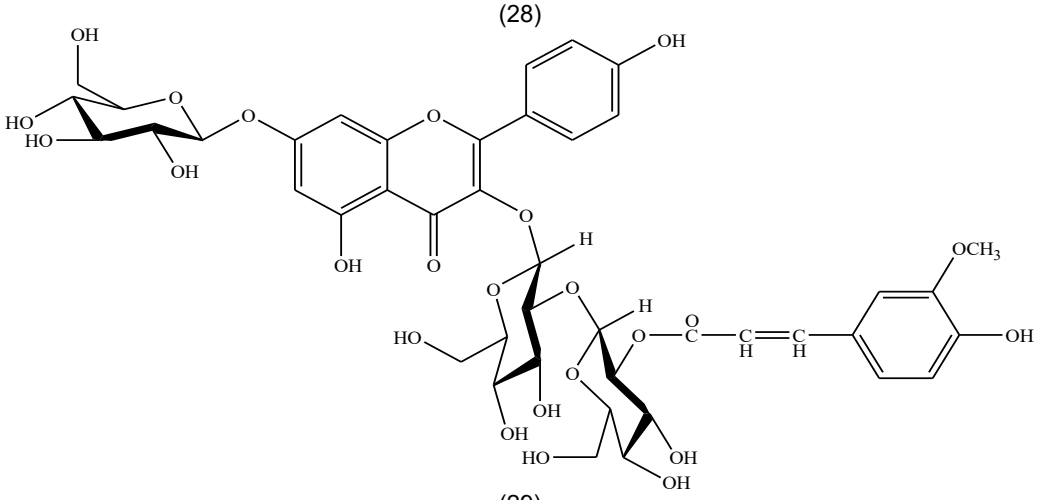
	R_1	R_2	R_3
27	Sinapoyl	H	H
38	5-hydroxy-feruloyl	H	H
43	Sinapoyl	Sinapoyl	H
45	Sinapoyl	H	Sinapoyl



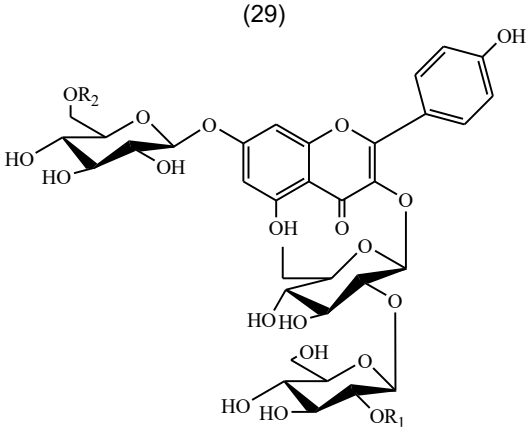
	R_1	R_2	R_3	R_4
37	Caffeoyl	H	H	H
42	Sinapoyl	Sinapoyl	H	H
44	Sinapoyl	Sinapoyl	Sinapoyl	H
46	Sinapoyl	Sinapoyl	H	Sinapoyl



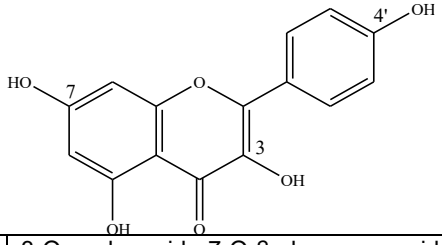
(28)



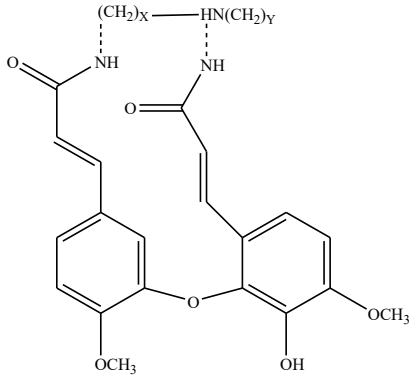
(29)



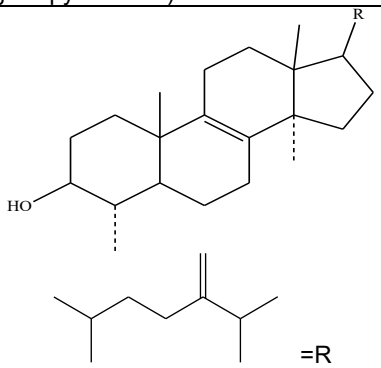
	R_1	R_2
30	H	H
31	Sinapoyl	H
32	Sinapoyl	*β*-D-glucosyl
33	H	*β*-D-glucosyl



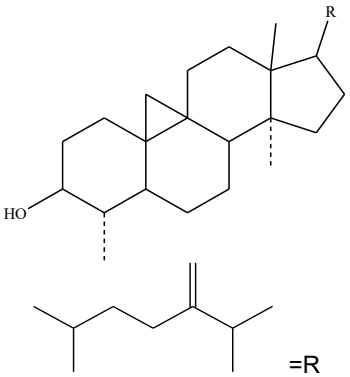
30	3-O-sophoroside-7-O-β-glucopyranoside
31	3-(2''-O-E-sinapoylsophoroside)-7-O-β-glucopyranoside
39	4'-(6-O-E-sinapoyl-β-glucopyranoside)-3,7-di-O-β-glucopyranoside
41	3-O-sophoroside-7-O-(2-O-E-sinapoyl-β-glucopyranoside)



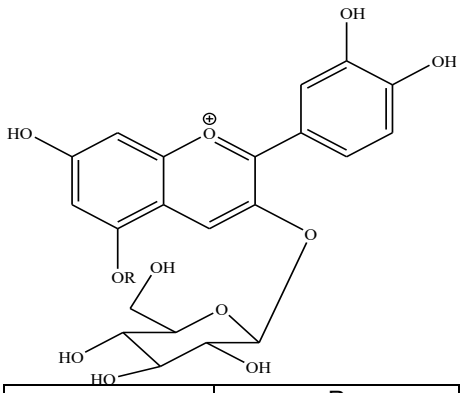
(40)
X+Y=7



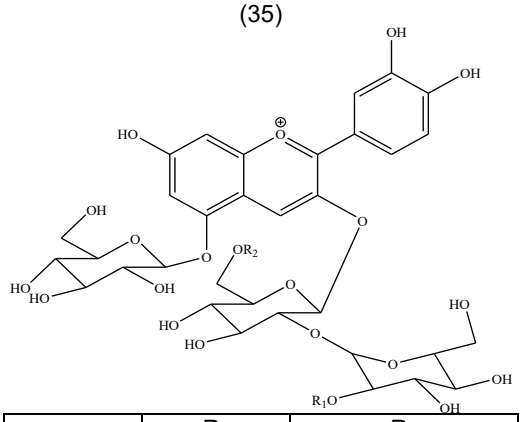
(34)



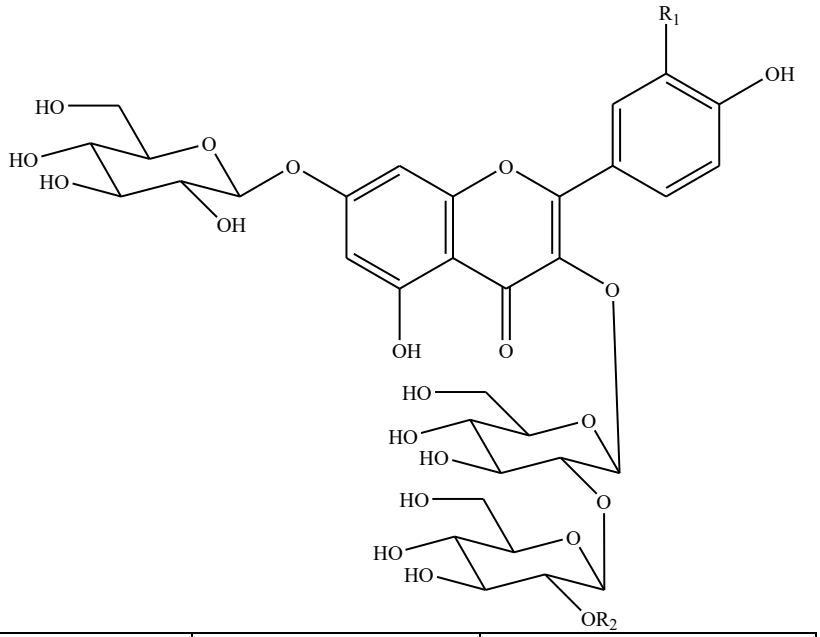
(35)



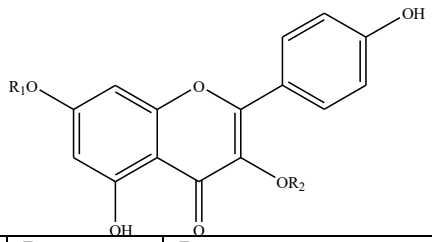
	R
47	H
48	glucose



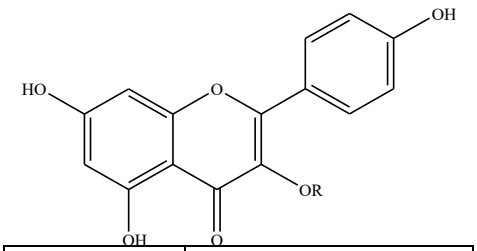
	R_1	R_2
49	H	H
50	H	p-coumaric
51	H	ferulic
52	H	sinapic
53	sinapic	p-coumaric
54	sinapic	ferulic
55	sinapic	sinapic



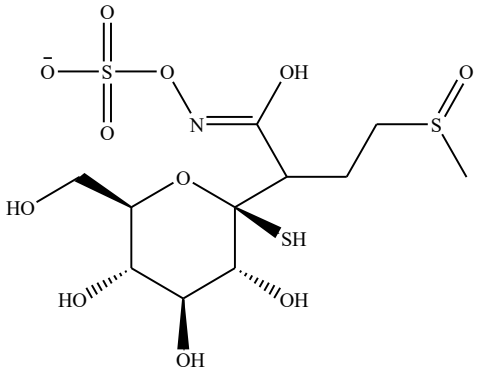
	R_1	R_2
30	H	H
31	H	Sinapoyl
29	H	Feruloyl
56	H	p-Coumaroyl
57	H	Caffeoyl
58	OH	Feruloyl
59	OH	Caffeoyl



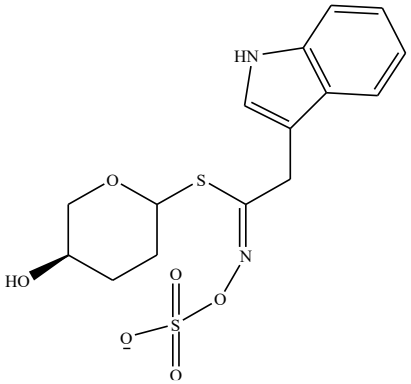
	R_1	R_2
60	Glucose	sophorotriose
61	Glucose	Sophorose-methoxycaffeic/ caffeic
30	Glucose	sophorose
62	Sophorose	sophorotriose
63	Sophorose	sophorose
64	sophorose	Glc-glc-glc-glc
31	Glucose	Sophorose- sinapic/caffeic
65	glucose	Sophorose- ferulic/caffeic



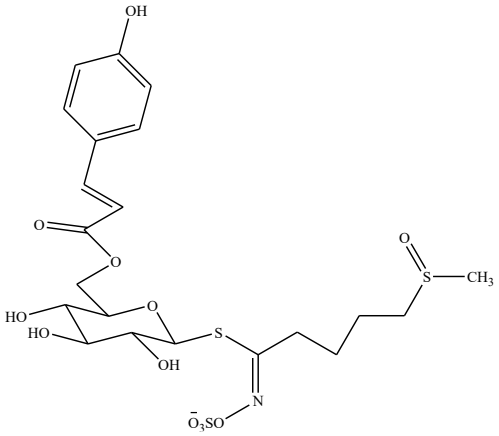
	R
66	sophorotriose
67	Sophorose- sinapic
68	Sophorotriose-ferulic
69	Sophorose- ferulic
70	Sophorose
71	glucose



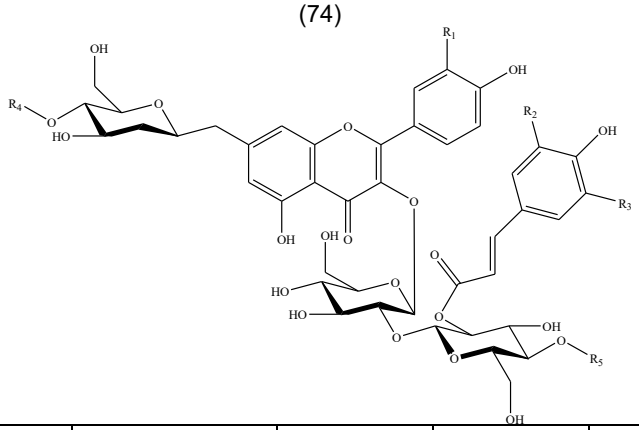
(72)



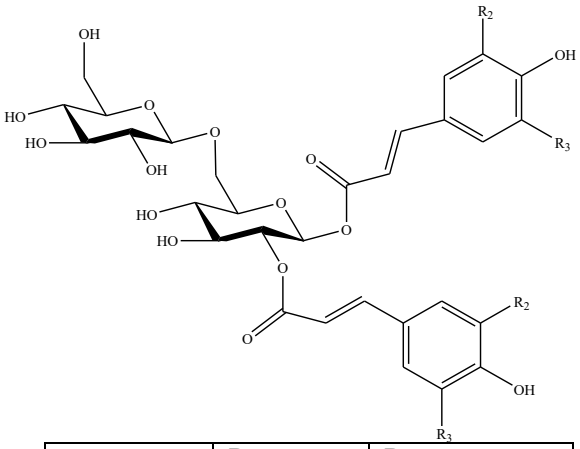
(73)



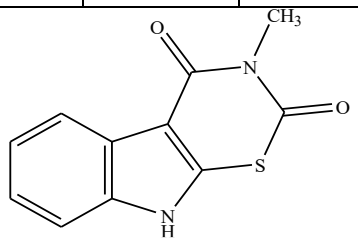
(74)



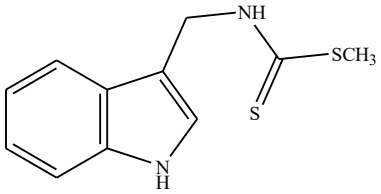
	R_1	R_2	R_3	R_4	R_5
75	H	OCH_3	OH	H	H
76	OH	OCH_3	OCH_3	H	H
77	OH	OCH_3	OCH_3	*β*-D-Glc	H
31	H	OCH_3	OCH_3	H	H
67	H	OCH_3	H	*β*-D-Glc	H
78	H	OCH_3	H	H	H
79	H	OCH_3	OCH_3	H	*β*-D-sinapoyl-Glc



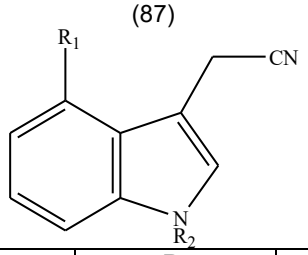
	R_2	R_3
80	OCH_3	OCH_3
81	OCH_3	OH



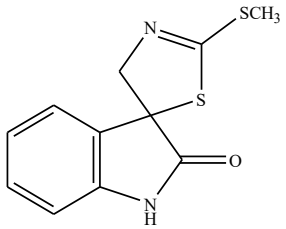
(84)



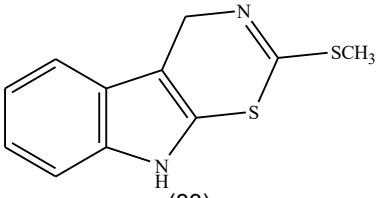
(87)



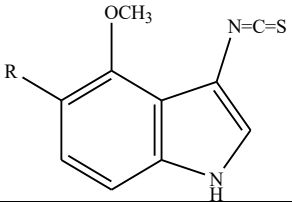
	R_1	R_2
90	H	H
91	H	OMe
92	OMe	H



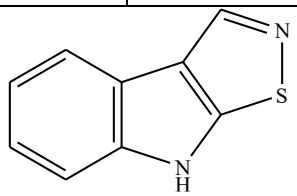
(82)



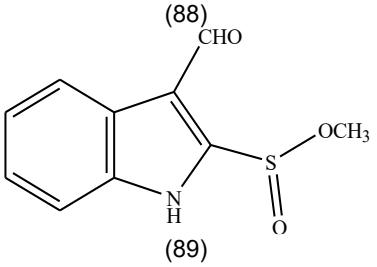
(83)



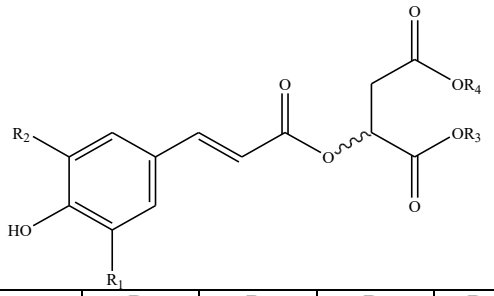
	R
85	H
86	OH



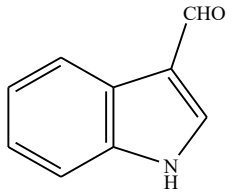
(88)



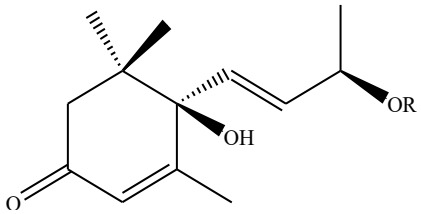
(89)



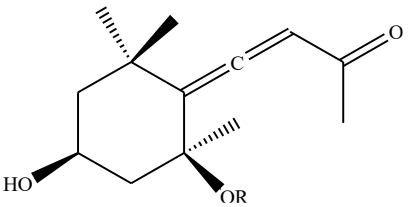
	R_1	R_2	R_3	R_4
94	OCH_3	H	CH_3	CH_3
95	OCH_3	OCH_3	CH_3	CH_3
96	OCH_3	H	CH_3	H
97	OCH_3	OCH_3	CH_3	H
98	OCH_3	H	H	CH_3
99	OCH_3	OCH_3	H	CH_3



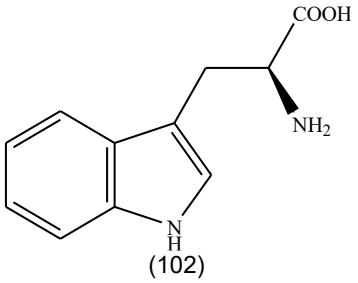
(93)



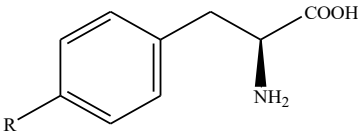
R= -β-D-Glc (100)



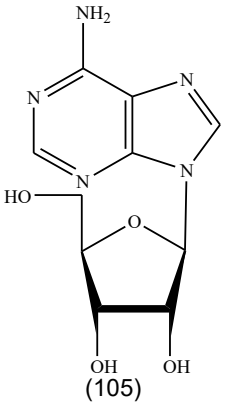
R= -β-D-Glc (101)



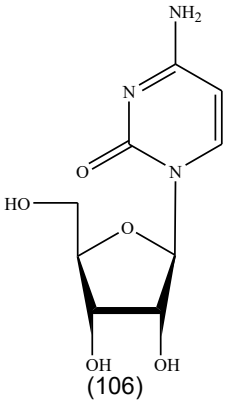
(102)



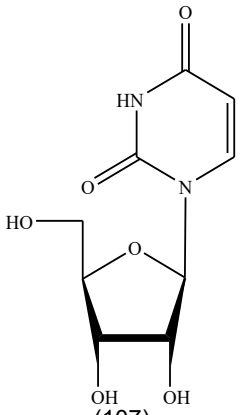
R=H (103)
R=OH (104)



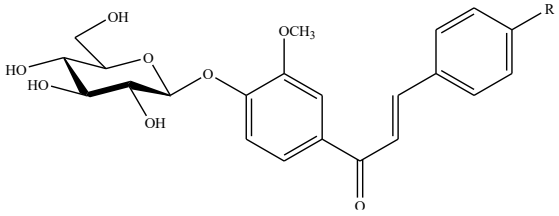
(105)



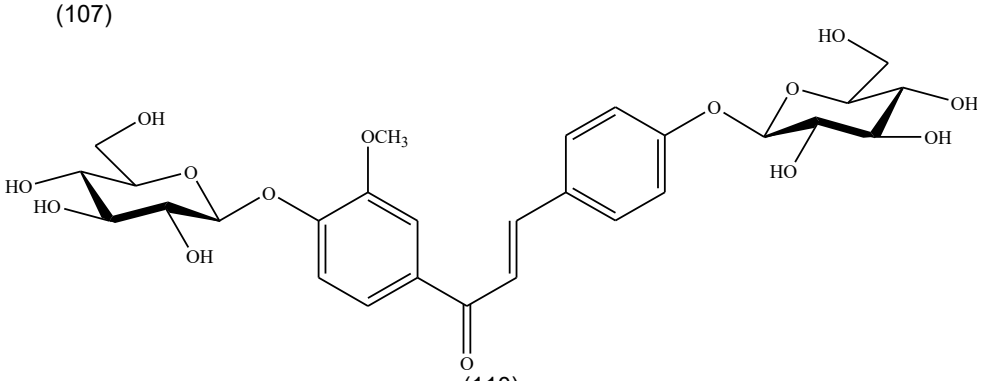
(106)



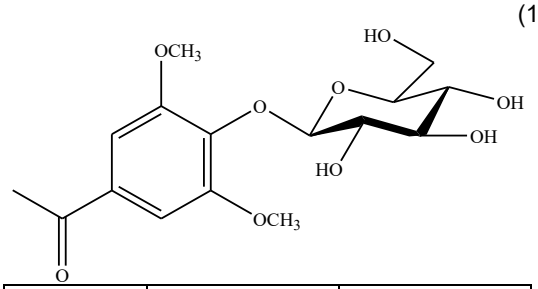
(107)



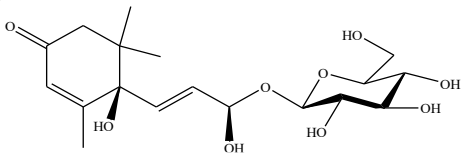
	R
108	H
109	OMe



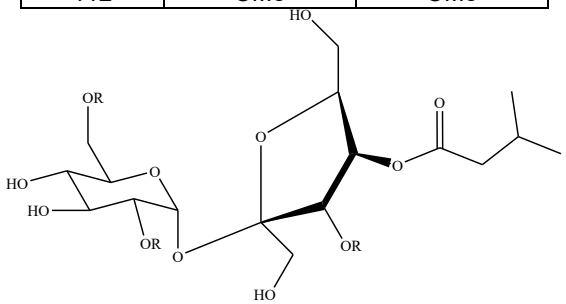
(110)



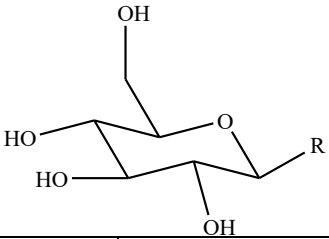
	R_1	R_2
111	H	H
112	OMe	OMe



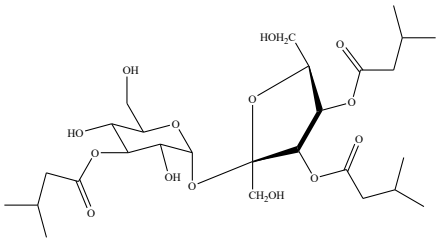
(113)



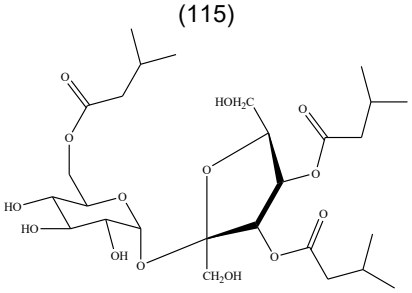
(114)



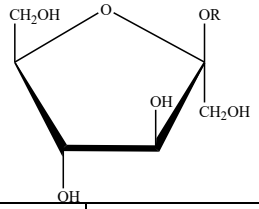
	R
117	CH_3CH_2O
119	$CH_3C{=}O$



(115)

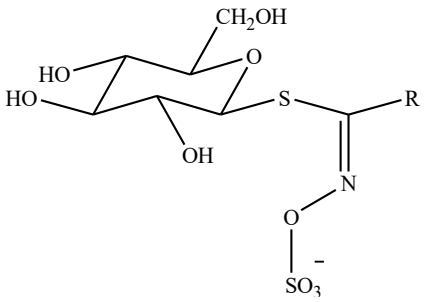


(116)



	R
118	$CH_3(CH_2)_3O$
120	$CH_3(CH_2)_4O$

Glucosinolates



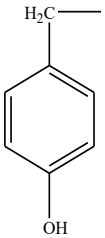
Aliphatic R-

CH_2=CH-CH_2-
Sinigrin
CH_2=CH-CH_2-CH_2-
Gluconapin
CH_2=CH-CH_2-CH_2-CH_2-
Glucobrassicanapin
$(CH_3)S(CH_2)_4$-
Glucoerucin
$CH_3SO(CH_2)_3$-
Glucoiberin
$CH_3SO(CH_2)_4$-
Glucoraphanin
$CH_3SO(CH_2)_5$-
Glucoallysin
$(CH_3)S(CH_2)_3$-
Glucoibervirin

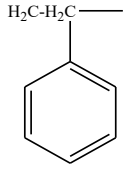
Hydroxy aliphatic

CH_2=CH-CHOH-CH_2-
Progoitrin
CH_3–SO–CH_2-CH_2-CH_2-CH_2-CH_2–
Glucoalyssin (GLA)
CH_2=CH-CH_2-CHOH-CH_2-
Napoleiferin

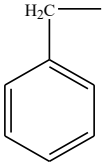
Cyclic



Sinalbin

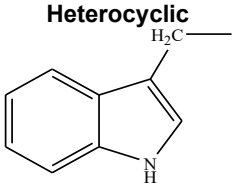


Gluconasturtiin

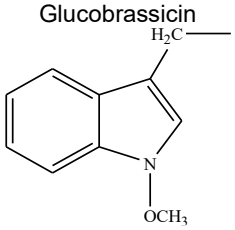


Glucotropaeolin

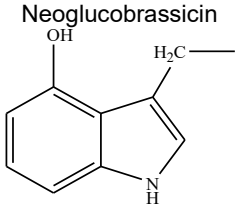
Heterocyclic



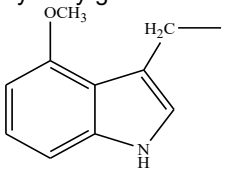
Glucobrassicin



Neoglucobrassicin



4-Hydroxy-glucobrassicin



4-Methoxy-glucobrassicin

References

1. Talrejaand, K.; Moon, A. *Int. J. Life Sci Pharma Res.***2014**,*4(4)*, 1.
2. Malan, R.; Walia, A.; Saini, V.; Gupta, S. *Eur. J. Exp. Biol.***2011**, *1 (2)*, 33.
3. Kumar, V.; Thakur, A. K.; Barothia, N. D.; Chatterjee, S. S. *TANG*, **2011**, *1(1)*, e2.
4. Soengas, P.; Sotelo, T.; Velasco, P.; Cartea, M.E. *Funct. Plant Sci. Biotechnol.***2011**, *2*, 43.
5. Cartea, M. E.; Fransico, M.; Soengas, P.; Velasco, P. *Molecules* **2011**, *16*: 251.
6. Liu, R.H.*J. Nut.***2004**, *134*, 3479S-3485S.

7. Kamel, A. M.; Souad, E. El-Gengaihi. *Not. Bot. Hort. Agrobot. Cluj.***2008**, *36 (2),* 80.
8. Khan, S. A; Shahid, S.; Jameel, M.; Ahmad, A. *Int. J. of Pharm. Chem.***2016***, 6(4),* 107.
9. Yu, J.C.; Jiang, Z.T.; Li, R.; Chan, S.M. *J. Food Drug Analysis.***2003**, *11(1)*, 22.
10. Prajapati, D.N.; Purohit, S.S.; Sharma, K.A.; Kumar, T. *A handbook of medicinal plants*, First edition; *2009*; 1, 540.
11. Tripathi, M.K.; Mishra, A.S.; Mondal, D.; Mishra, A.K.; Prasad, R.; Jakhmola, R.C. *Animal***2007**, *2(2)*, 207.
12. Wu, G.X.; Lin, Y.X.; Ou, M.R.; Tan, D.F. *Zhongguo Zhong Yao Za Zhi.* **2003,***28(7)*, 643.
13. Lako, J.; Trenerry, V. C.; Wahlqvist, M.; Wattanapenpaiboon, N.; Sotheeswaran, S.; Premier, R. *Food Chem.***2007**, *101(4)*, 1727.
14. Kruk, J.; Szyman´ska, R.; Cela, J.; Munne-Bosch, S. *Phytochemistry.***2014**, *108*, 9.
15. Siddiqui, R.; Wood, P. J.;Khanzada,G. *Carbohydr. Res.***1973**, *29*, 255.
16. Harbaum, B.; Hubbermann, E. M.; Wolff, C.; Herges, R.; Zhu, Z.; Schwarz, K. *J. Agric. Food Chem.***2007**,*55(20)*, 8251.
17. Bellostas, N.; Petersen, I. L.; Sørensen, J. C.; Sørensen, H.*J. Biochem. Biophys. Methods.* **2008**, *70*, 918.
18. Matsljmoto, T.; Shimizu, N.; Shigemoto, T.; Itoh, T.; Iida, T.; Nishioka, A. *Phytochemistry.***1983**, *22(3)*, 789.
19. Fabre, N.; Bon, M.; Moulis, C.; Fourastfazn, I.; Stanislas, E.*Phytochemistry.***1997**, *45(3)*, 525.
20. Hill, C.B.; Williams, P.H.; Carlson, D.G.; Tookey, H.L. *J. Amer. Soc. Hort. Sci.***1987**, *112(2)*, 309.
21. Luciano, F.B.; Holley, R.A. *Int. J. Food Microbiol.***2009**, *131(2-3),*240.
22. Karakida, F.; Ikeya, Y.; Tsunakawa, M.; Yamaguchi, T.; Ikarashi, Y.; Takeda, S. Aburada M. Biol. Pharm Bull. **2007**, *30(3)*, 514.
23. Khattab, R.; Eskin, M.; Thiyam,U. *J. Am. Oil Chem. Soc.***2013**, *91*, 89.
24. Li, J.; Ho, C.T.; Li, H.; Tao, H.; Tao, L. *J. Food Lipids.***2000**, *7 (1)*, 11.
25. Yathavakilla, S. V. K.; Shah, M.; Mounicoua, S.; Caruso, J. A. *J. Chromatogr. A.***2005**, *1100*, 153.
26. Pedras, M. Soledade C.; Chumala, Paulos B.; Jin, W.; Islam, Mohammed S.; Hauck, Dominic W. *Phytochemistry.* **2009**, *70*, 394.
27. Jung, H. A.; Woo, J. J.; Jung, M. J.; Hwang, G.S.; Choi, J. S. Arch. Pharm. Res.**2009**, *32(10),* 1379.
28. Ragasa, C. Y.; Ng, V. A. S.; Torres, O. B.; Sevilla, N. S.Y.; Uy, K. V. M.; Tan, M. C. S.; Noel, M. G.; Shen, C-C. *J. Chem. Pharm. Res.***2013**, *5(12)*, 1237.
29. Jyothi, T.C.; Sinha, S.; Singh, S.A.; Surolia, A.; Appu Rao, A.G. *Biochem. Biophys. Acta.***2007**, *1774(7)*, 907.
30. Itoh,T.; Uchikawa, K.; Tamuraand, T.; MatsuMoto, T. Phyt*ochemistry.* **1977***, 16,* 1448.
31. Grove, Michael D.; Spencer, Gayland F.; Pfeffer, Philip E.; Mandava, N.; J Warthen, J. D.; Worley, Joseph F.*Phytochemistry.***1978**, *17*, 1187.
32. Gul, M. K.; Amar, S. *J. Mol. Cell Biol.***2006**,*5*, 71.
33. Gruszka, J.; Kruk, J. *Chromatographia.***2007**, *66*, 909.
34. González, C.; Rodríg Graña, M. E.; Haro Bailón, V. M.; deVelascoPazos, A.; PabloOrdás Pérez, A.; *Euphytica*. **2008**, *159(1-2)*, 111.
35. Auger, B.; Marnet, N.; Ronique Gautier, VE´.; Maia-Grondard, A.; Leprince, F.; Renard, M.; Guyot, S.; Nesi, N.; Routaboul, J-M. *J. Agric. Food Chem.***2010**, *58*, 6246.
36. Ferreres, F.; Fernandes, F.; Sousa, C.; Valenta O, P.; Pereira, J. A.; Andrade, P. B.*J. Agric. Food Chem.***2009**, *57*, 8884.
37. Sivakumar, G.; Aliboni, A.; Bacchetta, L. *Food Chem.***2007**, *104*, 1761.

38. Gratacos-Cubarsi, M.; Ribas-Agusti, A.; Garcia-Regueiro, J.A.; Castellari, M. *Food Chem.***2010**, *121,* 257.
39. Huynh, N. T.; Smagghe, G.; Gonzales, G. B.; Camp, J. V.; Raes, K. *J. Agric. Food Chem.***2014**, *62*, 7468.
40. Fiol, M.; Adermann, S.; Neugart, S.; Rohn, S.; Mügge, C.; Schreiner, M.; Krumbein, A.; Kroh, L.W. *Food Res. Int.***2012**, *47*, 80.
41. Pedras, M.S.C.; Montaut, S.; Suchy, M.*J. Org. Chem.***2004b**, *69*, 4471.
42. Rězanka, T.; Sigler, K. *Phytochemistry.***2008**, *69*, 585.
43. Llorach, R.; Gil-Izquierdo, A.; Ferreres, F.; TomaäS-BarberaäN, F. A. *J. Agric. Food Chem.* **2003,** *51,* 3895.
44. Lo Scalzo, R.; Genna, A.; Branca, F.; Chedin, M.; Chassaigne, H. *Food Chem.* **2008**, *107*, 136.
45. Ahmed, M. F.; Rao, A. S. *Int.J. Sci. Res.***2013***, 2(8),* 421.
46. Volden, J.; Wicklund, T.; Verkerk, R.; Dekker, M. *J. Agric. Food Chem.* **2008**, *56,* 2068.
47. Charron, C. S.; Clevidence, B. A.; Britz, S. J., Novotny, J. A. *J. Agric. Food Chem.***2007**,*55*, 5354.
48. Jayaprakasam, B.; Olson, L. K.; Schutzki, R. E.; Tai, M.-H.; Nair, M. G.*J. Agric. Food Chem.* **2006**, *54*, 243.
49. Ding, M.; Feng, R.; Wang, S. Y.; Bowman, L.; Lu, Y.; Qian, Y.; Castranova, V.; Jiang, B.-H.; Shi, X. *J. Biol. Chem.* **2006**, *281*,17359.
50. Sousa, C.; Pereira, D. M.; Pereira, J. A.; Bento, A.; Rodrigues, M. A.; Dopico-García, S.; Valentão, P.; Lopes, G.; Ferreres, F.; Seabra,R. M.; Andrade, P. B. *J. Agric. Food Chem.* **2008**, *56,* 2231.
51. Ferreres, F.; Sousa, C.; Pereira, D. M.; Valenta˜o, P.; Taveira, M.;Martins, A.; Pereira, J. A.; Seabra, R. M.; Andrade, P. B. *Comb. Chem. High Throughput Screening.***2009**, *12*, 125.
52. Survay, N. S.; Kumar, B.;Jang, M.; Yoon, D.-Y.; Jung, Y.-S.; Yang, D.-C.; Park, S. W. *Bioorg. Med. Chem. Lett.***2012**, 22, 5555.
53. Chaudhary, A.; Sharma, U.; Vig, A. P.; Singh, B.; Arora, S.*Food Chem.***2014**,*148,* 373.
54. Fiol, M.;Adermann, S.; Neugart, S.; Rohn, S.; Mügge, C.;Schreiner, M.; Krumbein, A.; Kroh, L. W. *Food Res. Int.***2012**, *47*, 80.
55. Schmidt, S.; Zietz, M.; Schreiner, M.; Rohn, S.; Kroh, L.W.; Krumbein, A.*Rapid Commun. Mass Spectrom.***2010**, *24*, 2009.
56. Francisco, M.; Velasco, P.; Moreno, D. A.; García-Viguera, C.; Cartea, M. E. *Food Res. Int.***2010**, *43*, 1455.
57. Cartea, M. E.; de Haro, A.; Obregón, S.; Soengas, P.; Velasco, P. *Plant Foods Hum. Nutr.***2012**,*67*, 283.
58. Francisco, M.; Moreno, D.A.; Cartea, M.E.; Ferreres, F.; García-Viguera, C.; Velasco, P. *J. Chromatogr. A.***2009**, *1216*, 6611.
59. Pedras, M. S. C.; Zheng, Q.-A.; Gadagi, R. S.; Rimmer, S. R.*Phytochemistry*.**2008**, *69,* 894.
60. Ninomiya, M.; Efdi, M.; Inuzuka, T.; Koketsu, M.*Phytochem. Lett.***2010**, *3*, 96.
61. Wu, Q.; Cho, J.-G.; Lee, D.-S.; Lee, D.-Y.; Song, N.-Y.; Kim, Y.-C.; Lee, K.-T.; Chung, H.-G.; Choi, M.-S.; Jeong, T.-S.; Ahn, E.-M.; Kim, G.-S.; Baek, N.-I. *Carbohydr. Res.***2013**, *372*, 9.
62. Izu, H.; Hizume, K.; Goto, K.; Hirotsune, M. *Biosci. Biotechnol. Biochem.***2007**, *71*, 951.
63. Wiesner, M.; Zrenner, R.; Krumbein, A.; Glatt, H.; Schreiner, M. *J. Agric. Food Chem.* **2013**, *61*, 1943.
64. Marzouk, M. M.;Al-Nowaihi, A.-S. M.; Kawashty, S. A.; Saleh, N.A.M. *Biochem. Syst. Ecol.***2010**, *38*, 680.

❑❑❑