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Phytopharmacological importance of traditional healer tree: Golden Shower

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Abstract

Golden Shower or cassia fistula is most widespread deciduous or semi-evergreen tree of Indian subcontinent. Cassia is widely planted in gardens and societies due to its ornamental and medicinal properties. *Cassia fistula* has therapeutic importance in health care from ancient time. Almost all parts of this tree are having pharmacological actions. Cassia fistula is used against various diseases from primeval time. Researchers have suggested the extracts of cassia fistula for controlling blood sugar level, anti-inflammatory action, hepatic diseases and cancer etc. Extensive work has been done on this plant and many chemical constituents have been isolated are useful against several diseases. More than 40 chemical constituents have been isolated from *Cassia fistula* are used for healing and treatment of various diseases so it is also called traditional healer tree.

Key-Words: *Cassia fistula*, Pharmacological, Phytochemical

Introduction

The drug consists of ripe fruits and fruit pulp of *Cassia fistula* Linn. family Caesalpiniaceae[1]. The tree of *Cassia fistula* is decorated with thick clusters of showy yellow blooms in summer season, which look like shower so it is commonly known as 'golden shower'. It is a well-known plant in the Ayurvedic system of medicine. The plant is found throughout India in all deciduous forests and hilly tracts. It is cultivated as an ornamental plant for its beautiful yellow flowers [2]. *Cassia fistula* has traditionally been used to treat leprosy, tuberculosis, syphilis, rheumatism, skin disease [3]. The Ayurvedic pharmacopoeia of India indicated the fruit pulp for constipation, colic, chlorosis and urinary disorders [4].The fruit of *Cassia fistula* is used to treat diabetes [5]. *Cassia fistula* plant is rarely ever wholly leafless, but in some localities it is almost bare between March and May and new leaves appear during April-July. The flowers appear along with the leaves, in dry areas the flowers however appear till October [6]. The various chemical constituents isolated from the plant are fistucacidin, leucocyanidin, leucopelargonidin, hexacosanol, lupeol, and β-sitosterol[7].

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Current research on *Cassia fistula* has focused on its hepatoprotective, antioxidant, anticancer, anti-inflammatory and other reported activities [8]. This review on *Cassia fistula* presents the chemical and pharmacological investigations so far reported.

Pharmacological investigations

Hepatoprotective activity

Hepatoprotective activity of the n-heptane extract of *Cassia fistula* leaves was investigated in rats by inducing hepatotoxicity with carbon tetrachloride: liquid paraffin (1:1). The extract has been shown to possess significant protective effect by lowering the serum levels of transaminase (SGOT and SGPT), bilirubin and alkaline phosphatase (ALP).The extract of *Cassia fistula* at a dose of 400 mg/kg showed significant hepatoprotective activity which was comparable to that of a standard hepatoprotective agent [9-11]

Antitumor activity

Effects of methanolic extract (ME) of *Cassia fistula* seed on the growth of Ehrlich ascites carcinoma (EAC) and on the life span of tumor bearing mice were studied. ME treatment showed an increase of life span, and a decrease in the tumor volume and viable tumor cell count in the EAC tumor hosts. Cytological studies have revealed a reduction in the mitotic activity, and the appearance of membrane blebbing and intracytoplasmic vacuoles in the treated tumor cells.

Improvement in the hematological parameters following ME treatment, like hemoglobin content, red blood cells count, and bone marrow cell count of the tumor bearing mice have also been observed. The results of the study suggest that ME of *Cassia fistula* seed has an antitumor activity [12]

Laxative activity

The *in-vitro* effect of *Cassia fistula* infusion on isolated guinea-pig ileum was examined. The acute and sub chronic toxicity of the infusion of *Cassia fistula* and *Cassia acutifolia* pods taking senokot tablet as the reference drug were also determined. The results obtained for *Cassia fistula* infusion when compared with senokot tablet showed that the infusion of *Cassia fistula* pods possessed very low levels of toxicity, having the LD_{50} of 660 mg/kg and also without any pathological effects on the organs examined microscopically. It is therefore concluded from the study that *Cassia fistula* pods infusion could be safely utilized as laxative drugs and as a substitute for the official senna[13-14]

Antioxidant activity

Aqueous extract of *Cassia fistula* flowers (ACF) was screened for its antioxidant effect in alloxan induced diabetic rats. An appreciable decrease in per oxidation products viz thiobarbituric acid reactive substances, conjugated dienes, hydro peroxides was observed in heart tissues of ACF treated diabetic rats. The decreased activities of key antioxidants enzymes such as super oxides dismutase, catalase, glutathione peroxides, glutathione reductase and glutathione in diabetic rats were brought back to near normal range upon ACF treatment. These results suggest that ACF has got promising anti oxidative activity in alloxan diabetic rats.[15-17]

Anti-inflammatory activity

Anti–inflammatory activities of the aqueous and methanolic extract of the *Cassia fistula* were assayed in the wistar albino rats. The extracts were found to possess significant anti-inflammatory effect in both acute and chronic models.[18]

Antibacterial activity

Various fractions of *Cassia fistula* fruit pulp have been studied for *in vitro* antibacterial activity against urinary pathogens i.e. *E. coli, P. mirabilis, P. aeruginosa,* and *K. pneumoniae.* All fractions showed inhibitory activity against all test pathogens but maximum inhibition was seen with ethanol fraction. *K. pneumoniae* and *P. aeruginosa* were more sensitive as compared to *E. coli* and *P. mirabilis.*[19-22]

Antifungal activity

Hexane, chloroform, ethyl acetate, methanol and water extracts from the flower of *Cassia fistula* were tested against bacteria and fungi .All the extract exhibited antibacterial activity against Gram-positive organism with minimum inhibitory concentration (MIC) between 0.078 and 2.5 mg/ml. Among the Gram-negative bacteria, only *Pseudomonas aeruginosa* was susceptible to the extracts. Ethyl acetate crude extract was fractionated using chromatographic technique. A crystal was isolated, which was confirmed as 4-hydroxy benzoic acid hydrate using X-ray crystallography. It exhibited antifungal activity against *Trichophyton mentagrophytes* (MIC 0.5 mg/ml) and *Epidermophyton floccosum* (MIC 0.5 mg/ml).[23-24]

Antileishmanial activity

Crude extracts and fractions from the fruits of *Cassia fistula* were tested against the most dramatic and fatal disease form of leishmaniasis, the visceral form (VL). Hexane extract from the fruits showed significant antileishmanial activity against the promastigote form of leismania *L. Chagasi*. The bioguided fractionation resulted in the isolation of a sterol, clerosterol, promastigotes presented an inhibitory concentration 50% (IC_{50}) of 10.03 µg/ml and intracellular amastigotes demonstrated high susceptibility, with an IC_{50} of 18.10 µg/ml. Mammalian cytotoxicity was evaluated and it was demonstrated that clerosterol was 3.6 fold less toxic than the standard drug pentamidine.[25]

Antiviral activity

It was possible to infect the callus culture of *C. fistula* by Ranikhet disease virus (RDV) and an animal virus under certain well defined conditions. The high concentration of RDV would induce in these callus cultures the production of an interferon like antiviral factor which appears to be heat stable, more resistant to trypsin and possessed better protective and therapeutic values than chick interferon.[26]

Wound healing activity

Methanol extract of *Cassia fistula* leaves were examined for its wound healing property in the form of an ointment in two types of wound models in rats, Excision wound model and Incision wound model.

The ointment of the leaf extract of two different concentrations (5% and 10% w/w ointment of leaves extract in simple ointment base) responded significantly in both models of wounds tested. The results were comparable to standard drug nitrofurazone in terms of wound contraction ability, epithelisation period, tensile strength and regeneration of tissue at wound area.[27]

Larvicidal and ovicidal activity

Methanolic leaf extract of *Cassia fistula* was tested for larvicidal and ovicidal activity against *Culex quinquefasciatus* and *Anophelas stephensi*. The extract

was found to be more lethal to the larvae of *A. stephensi* than *C. quinquefasciatus* with LC_{50} values of 17.97 and 20.57 mg/l respectively. Mean percentage hatchability of the ovicidal activity was observed 120 hours after treatment. The percentage hatchability was inversely proportional to the concentration of extract and directly proportional to the eggs. The egg raft of *C. quinquefasciatus* was found to be more hatchable than *A. stephensi*.[28]

Phytochemical Investigations

Extensive studies have been carried out on *Cassia fistula*. Various chemical constituents of biological importance isolated from root, seed, leaf, bark, flower and pod have been presented in Table 1.

Conclusion

The extensive survey of literature revealed that *Cassia fistula* is an important medicinal plant with diverse pharmacological spectrum. Besides having the above mentioned pharmacological properties, it has also been used as an ingredient of many herbal formulations which are used for the treatment of various diseases. Further evaluation needs to be carried out on *Cassia fistula* in order to explore the concealed areas and their practical clinical applications, which can be used for the welfare of the mankind.

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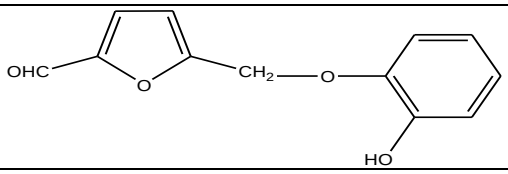
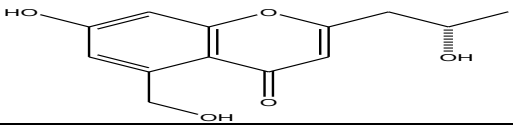
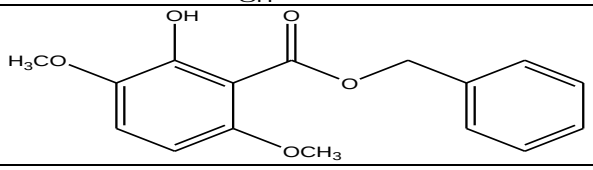
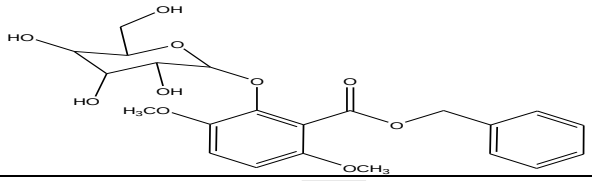
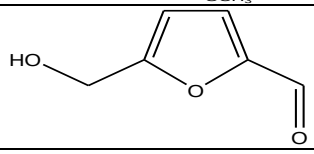
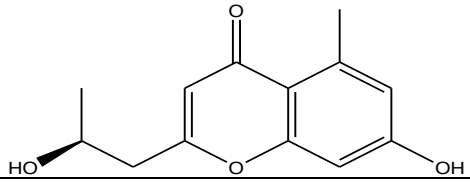
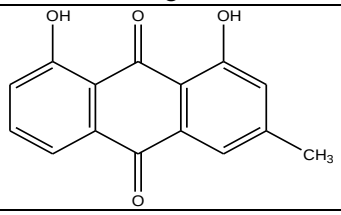
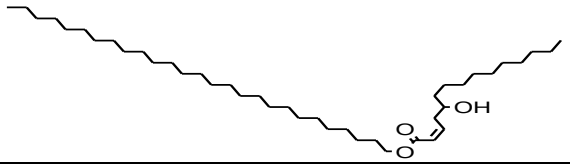
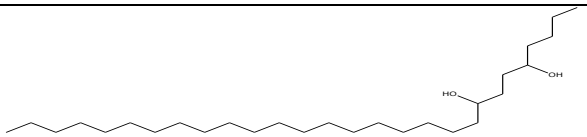
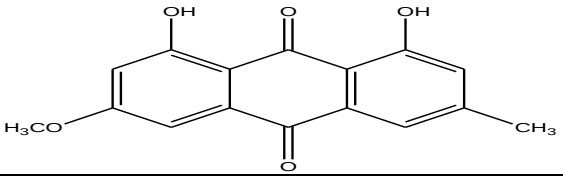
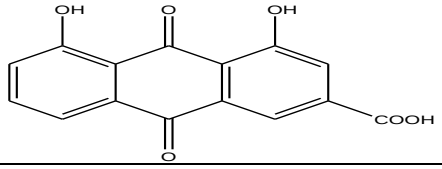
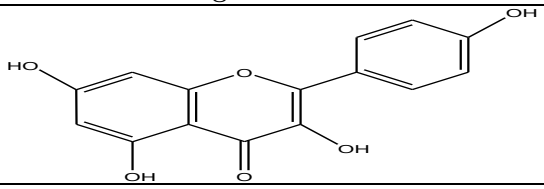
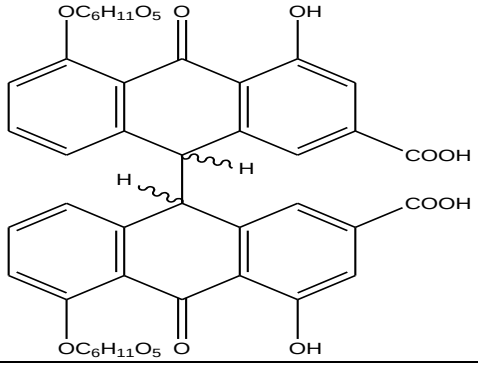
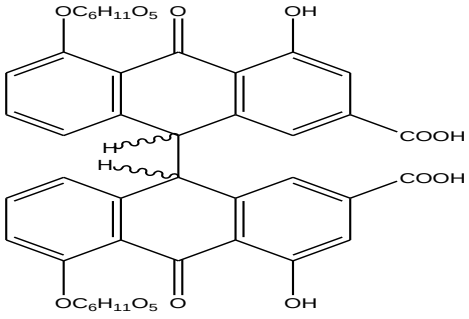
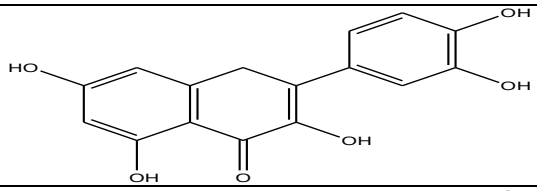
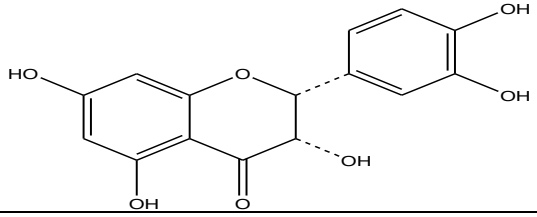
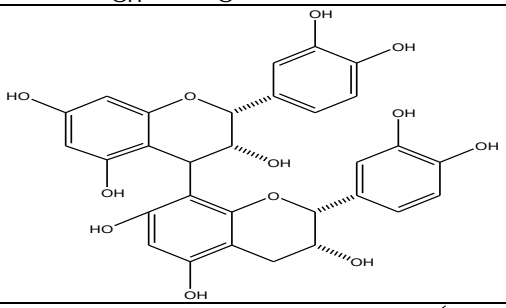
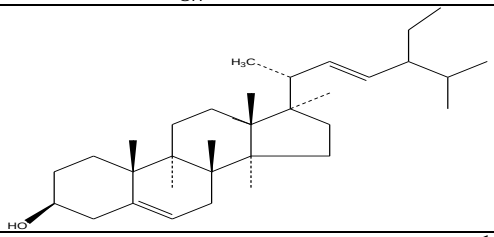
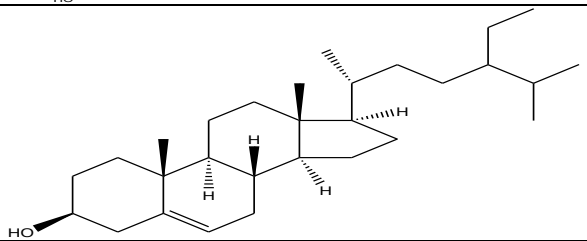
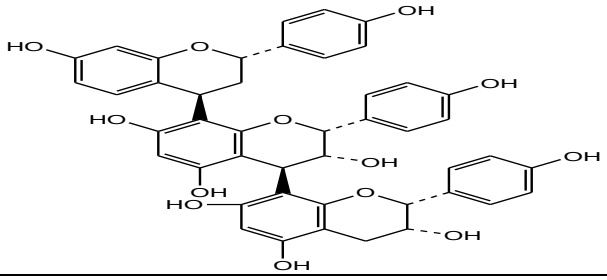
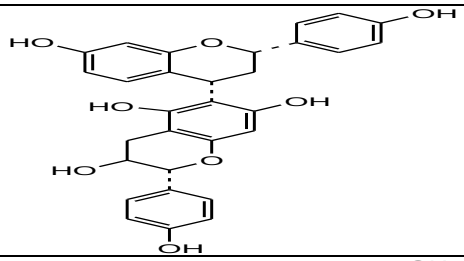
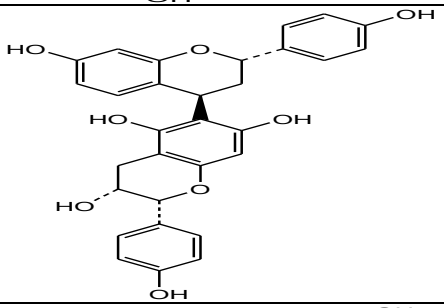
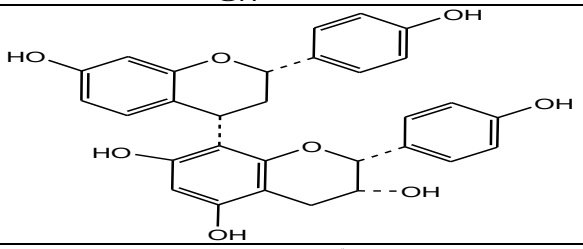
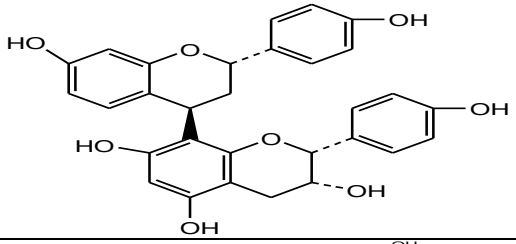
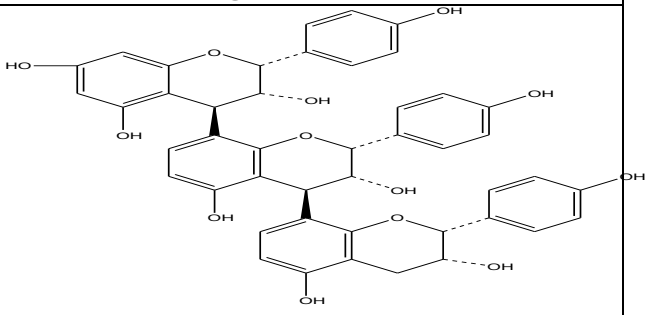
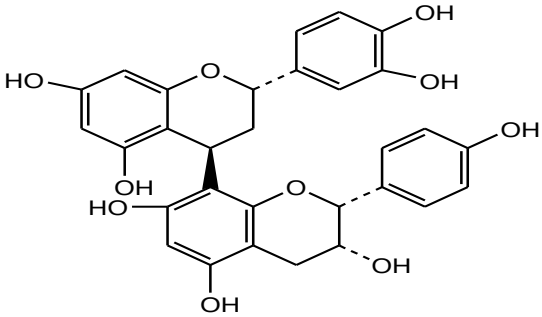
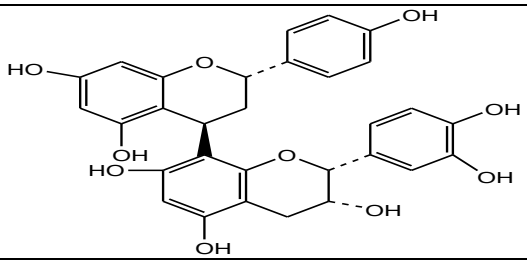
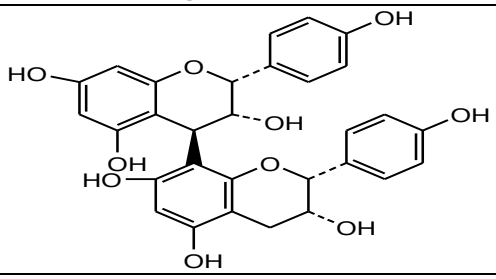
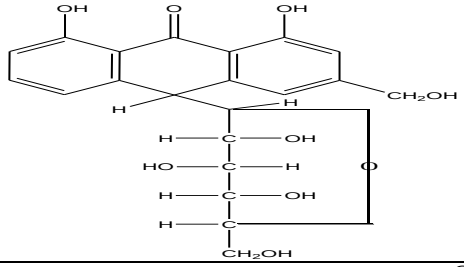
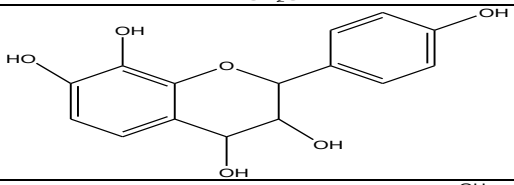
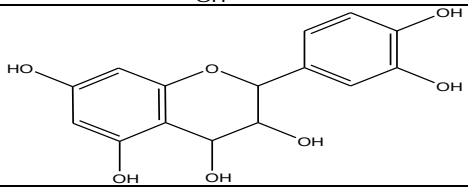
Table 1: Chemical constituents of C*assia fistula* found in various plant parts

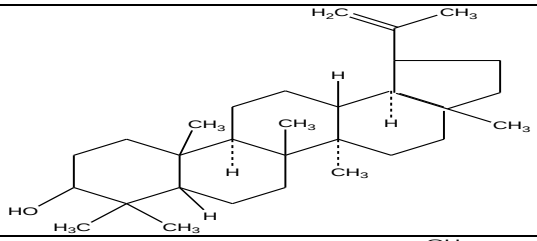
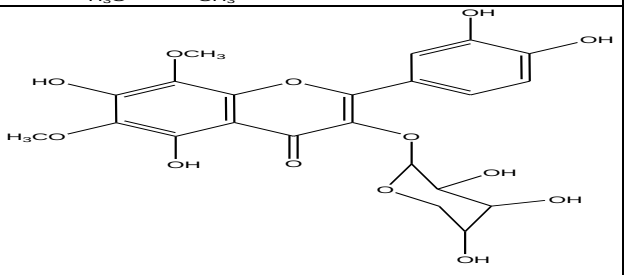
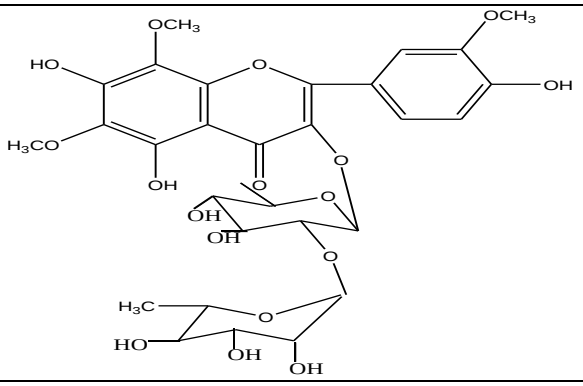
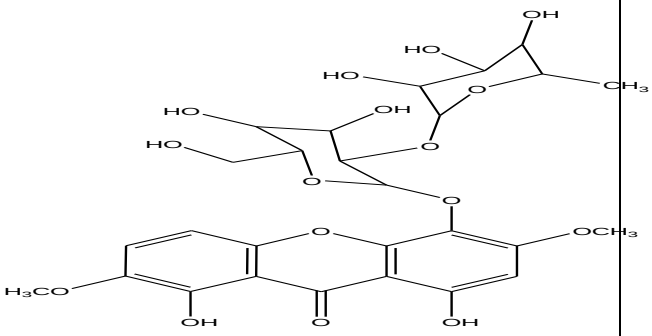
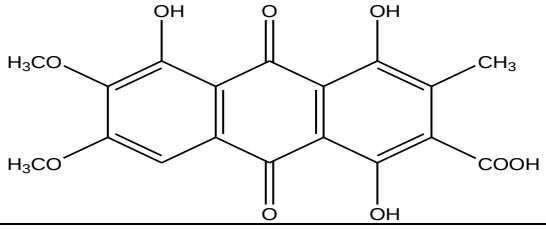
S/ No	Constituents isolated	Parts	Reference	Chemical structure
1.	5-(2-hydroxyphenoxymethyl)furfural	Seeds	[29]	
2.	(2S)-7-hydroxy-5-hydroxymethyl-2-(2′-hydroxypropyl)chromone	Seeds	[29]	
3.	Benzyl-2-hydroxy-3,6-dimethoxybenzoate	Seeds	[29]	
4.	Benzyl-2β-O-D-glucopyranosyl-3,6-dimethoxybenzoate	Seeds	[29]	
5.	5-hydroxymethylfurfural	Seeds	[29]	
6.	(2′S)-7-hydroxy-2-(2′-hydroxypropyl)-5-methylchromone	Seeds	[29]	
7.	Chrysophanol	Seeds	[29]	
8.	Cis-heptacosanyl-5-hydroxypentadec-2-enoate	Leaves	[30]	
9.	Octacosan-5,8-diol	Leaves	[30]	

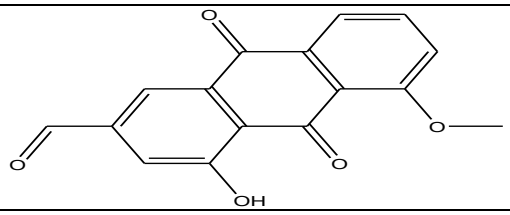
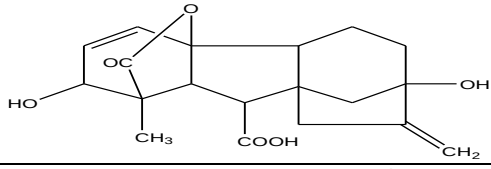
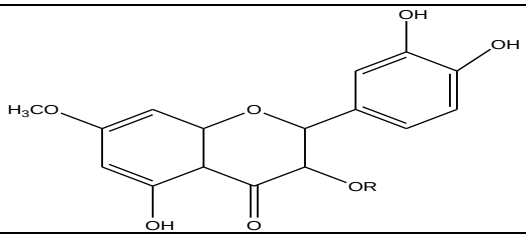
				
10.	Physcion	Leaves	[31]	
11.	Rhein glycoside	Leaves	[32]	
12.	Kaempferol	Leaves	[33]	
13.	Sennoside A	Leaves	[33]	
14.	Sennoside B	Leaves	[33]	

15.	Quercetin	Leaves	[34]	
16.	Epicatechin	Leaves	[34]	
17.	Procyanidin B2	Leaves	[35]	
18.	Stigmasterol	Leaves	[36]	
19.	β-Sitosterol	Leaves	[36]	
20.	(2S)-7,4′-dihydroxyflavan-(4β→8)-epiafzelechin-(4β→8)-epiafzelechin	Leaves	[37]	
21.	(2S)-7,4′-dihydroxyflavan-(4α→6)-epiafzelechin	Leaves	[38]	

				
22.	(2S)-7,4′-dihydroxyflavan-(4β→6)-epiafzelechin	Leaves	[39]	
23.	(2S)-7,4′-dihydroxyflavan-(4α→8)-epiafzelechin	Leaves	[40]	
24.	(2S)-7,4′-dihydroxyflavan-(4β→8)-epiafzelechin	Leaves	[41]	
25.	Epiafzelechin-(4β→8)-epiafzelechin-(4β→8)-epiafzelechin	Leaves	[42]	

26.	Epicatechin-(4β→8)-epiafzelechin	Leaves	[43]	
27.	Epiafzelechin-(4β→8)-epicatechin	Leaves	[44]	
28.	Epiafzelechin-(4β→8)-epiafzelechin	Leaves	[45]	
29.	Barbaloin	Pulp	[46]	
30.	Fistucacidin(3,4,7,8,4′-pentahydroxyflavon)	Bark	[47]	
31.	Leucocyanidin	Bark	[47]	

32.	Lupeol	Bark	[47]	
33.	5,7,3,4′-tetrahydroxy6,8-dimethoxyflavone-3-o-α-arabinopyranoside	Bark	[48]	
34.	5,7,4′-trihydroxy-6,8,3′-trimethoxyflavone-3-o-α-L-rhamno-pyranosyl-(1→2)-o-β-D-galactopyranoside	Bark	[48]	
35.	1,8-dihydroxy-3,7-dimethoxyxanthone-4-o-α-L-rhamno-pyranosyl-(1→2)-o-β-D-galactopyranoside	Bark	[48]	
36.	Fistulic acid	Pods	[49]	

37.	3-formyl-1-hydroxy-8-methoxyanthraquinone	Pods	[50]	
38.	Gibberellic acid	Flower	[51]	
39.	Rhamnetin-3-o-Gentiobioside	Roots	[52]	

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