Progress in the Research on Naturally Occurring Flavones and Flavonols: An Overview

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Abstract: The present review deals with recently reported novel natural flavones and flavonols (mid-1999 to early 2004), along with various biological and pharmacological activities as exhibited by these important groups of flavonoids. The present resumé lists 252 new naturally occurring flavones and flavonols reported during the period. Natural distribution by plant family of the flavonoids is considered; a variety of plant species belonging to fifty-two different plant families is mentioned as their natural sources. Therapeutic efficacies of these constituents are also cited. The review covers 231 references.

INTRODUCTION

Flavones and flavonols (*i.e*. simple flavones substituted at the 3-position by a hydroxyl group) are the most abundant classes of the naturally occurring polyphenolic compounds, the flavonoids. Flavonoids are widely distributed throughout the plant kingdom and are of importance and interest to a wide variety of physical and biological scientists. Continuing work on their chemistry, occurrence, natural distribution and biological function have already resulted in a number of reviews [1-5]. In this review we have attempted to represent the recent developments in the research on naturally occurring flavones, flavonols and their gycosides. These special groups of flavonoid compounds have already created a stir in the field of chemical and biological sciences due to their immense biological and pharmacological/therapeutic potential.

BIOLOGICAL AND PHARMACOLOGICAL ACTIVITIES

Naturally occurring flavones, flavonols and their derivatives show promising biological and pharmacological activities. In recent times, due to these activities, the chemistry as well as the pharmacology of these groups of flavonoids has been of much interest to the scientific community at large. Different activities shown by these phytochemicals are cited below.

Antioxidant Activity

Free radical decomposition results in a large number of human diseases [6,7]. Flavonoids exhibit significant antioxidant efficacy acting as free radical scavengers. Quercetin, luteolin, isothymusin (6,7-dimethoxy-5,8,4'-trihydroxyflavone), kaempferol and its glycosides showed radical scavenging activity on the DPPH radical (1,1-diphenyl-2-picryl hydrazyl) [8-11].

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The flavonoids - rutin, isorhamnetin glycosides, quercetin glycosides and **222** - isolated from the water-soluble fraction of peanut skins (*Arachis hypogaea*) were found to have significant free radical scavenging activities on the DPPH radical; the investigators [12] evaluated the IC_{50} values of about 1.0 ~3.5 μM for them. They also reported that the flavonoids protect the seed fat from autoxidation and exhibit a significant inhibitory effect towards protein glycation. Kinghorn *et al* [13] examined the antioxidative property in the DPPH assay of the flavonoids **246** and kaempferol-3-*O*-neohesperidoside, isolated from the leaves of *Daphniphyllum calycinum*. The compounds with IC_{50} values of 43.2 and 79.6 μg/mL, respectively, exhibited moderate activities as free radical scavengers in the DPPH assay in comparison with reference antioxidatives, such as ascorbic acid, 2(3)-*tert*-butyl-4-hydroxyanisole, caffeic acid, gallic acid and nordihydroguaiuretic acid, the IC_{50} values of which are 22, 21, 12, 5 and 12 μg/mL respectively [13]. The less potent antioxidant activity of the latter in comparison to **246** must be associated with one less phenolic hydroxyl group present in the molecule. Midiwo *et al*.[7] reported that the flavonoids present in *Erythrina burttii*, *E. sacleucxii*, *E. abyssinica*, *Milletia dura* and *M. usaramensis* have anti-, oxidant activities [14].

The flavonoids - **146**, **213** and glycosides of kaempferol, quercetin and isorhamnetin - isolated from a *n*-butanol extract of *Ginkgo biloba* (leaves) were found to show profound antioxidant activities as evaluated by Tang *et al*. in DPPH and cytochrome-c-reduction assays using the HL-60 cell culture system [15]. Most of the compounds exhibited inhibitory activity as strong as the positive control against TPA -induced free radical formation in a HL-60 cell culture system and showed free radical scavenging activity in the DPPH assay. Generally, the presence of hydroxyl substituents on the flavonoid nucleus enhances the activity, whereas substitution by methoxyl groups diminishes antioxidant activity. It has also been established that the di-OH substitution at 3' & 4' of the B-ring is particularly important for the oxygen radical absorbing activity of a flavonoid.

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Aquino *et al*. [16] reported that the methanolic extract of *Anthurium versicolor* leaves possesses free radical scavenging effectiveness on DPPH (EC_{50} = 142.6 μg/mg), which seems to be correlated to its total phenolic content (190.6 μg/mg). The extract was found to contain, as major components, a series of glycosyl flavones, such as compounds **98-101** and vitexin, and other phenolic compounds, such as rosmarinic acid. The antioxidant activity of the phenolic pool contained in the whole alcoholic extract of *A. versicolor* was potentiated when the extract was fractionated to give a fraction which showed a lower EC_{50} (47.7μg/mg) correlated to a higher total phenol level (319.9 μg/mg). Also the concentration of C-glycosyl flavones **98**, **100** and vitexin was higher in the fraction [16].

The flavonol triglycosides, calabricoside A **187** and calabricoside B **188**, isolated from the aerial parts of *Putoria calabrica* were reported to exhibit high free radical scavenging activity with nearly identical efficacy (IC_{50} = 0.25 and 0.3 μM, respectively) [17]. Interestingly, the additional caffeic acid moiety of compound **188** did not enhance the radical scavenging activity, despite the high activity of caffeic esters themselves.

Quercetin was shown to exert a protective effect in resper fusioischemic tissue damage [18-20]. Stabilisation of meat lipids with flavonoids has been studied, and morin, myricetin, kaempferol and quercetin at a level of 200 ppm were found to be most effective [21]. The said flavonoids have also been suggested as stabilizers for fish oil as an alternative to synthetic antioxidants [22]. Pratt [23] investigated the antioxidant effects of several flavonoids on beef slices and in carotene-lard solutions. Both quercetin and myricetin and their 3-glycosides, were significantly effective antioxidants at concentrations ranging from 0.4 to $2.5x10^{-5}$ M. The antioxidant effects are attributed due to chelation of metallic ions and accepting free radicals [24]. Quercetin is an effective antioxidant for fatty acid methyl esters of sunflower oil or linseed oil [25]. It has been observed that methylation of quercetin at the 3- or 5-positions slightly reduces its effectiveness while methylation at either the 3'- or 4'-positions drastically reduces the antioxidant abilities. In 1969 Van Fleet [26] suggested that a major function of flavonoids is to serve as antioxidants for lipids and polyacetylenes in plant tissues. Flavonoids inhibit low-density lipoprotein (LDL)-oxidation and a number of mechanisms are likely to play a rôle. Flavonoids may directly scavenge some radical species by acting as chain breaking antioxidants [27]. In addition, they may recycle other chain breaking antioxidants such as α−tocopherol by donating a hydrogen atom to the tocopherol radical [28]. The ability of quercetin, and the quercetin glycosides to protect LDL against oxidative modification has been shown to be satisfactory [29-31]. Brown and Rice-Evans [32] examined the free radical scavenging properties of a luteolin-rich artichoke extract and some of its pure flavonoid constituents by assessing their ability to prevent Cu^{2+}-low-density lipoprotein (LDL) oxidation. Pure aglycone, luteolin (1 mM), demonstrated an efficacy similar to that of 20μg/mL artichoke extract in inhibiting lipid peroxidation. Luteolin-7-*O*-glucoside, one of the glycosylated forms in the diet also demonstrated a dose-dependent reduction of LDL oxidation that was less effective than that of luteolin. The experimental results demonstrate that the antioxidant activity of the artichoke extract relates in part to its constituent flavonoids which act as hydrogen donors and metal ion chelators and the effectiveness is further influenced by their partitioning between aqueous and lipophilic phases. Noroozi *et al*. [33] studied the antioxidant potencies of several widespread dietary flavonoids (*viz*. luteolin, myricetin, quercetin, kaempferol, quercetin-3-rhamnoside, apigenin, quercetin-3-glucoside, rutin) regarding dose-dependent reductions in oxidative DNA damage to human lymphocytes; the resulting data suggest that the free flavonoids are more protective than the conjugated flavonoids—the fact is consistent with the hypothesis that antioxidant activity of free flavonoids is related to the number and position of hydroxyl groups. This fact is substantiated by the observation that quercetin tetramethyl ether, which has methoxy groups instead of hydroxy groups at the 3,7,3',4'-positions, and phloretin, with an open chain C-ring, showed lesser antioxidative activity [34].

Cardio-Protective Effect

Flavonoids have been reported to have actions on the heart. The parent flavone itself possesses coronary dilatory action and was commercially available under the name ‘Chromocor’ and its combination with rutin and isoquercetin was also available with brand name ‘Flavoce’, useful in the treatment of atherosclerosis [1]. 3-Methyl-quercetin has been reported to exhibit a positive chronotropic effect on guinea pig right atrium and antiarrhythmic effect on left atrium [35]. 7-Monohydroxy ethyl rutoside and 7,3',4'-trihydroxy ethyl rutoside have recently been reported to show inhibitory activity against doxorubicin-cardiotoxicity (negative inotropic effect) on the mouse left atrium [36]. Luteolin showed a vasorelaxant effect on rat thoracic aorta and the glycosides of luteolin, apigenin and genistein exhibit antihypertensive activity greater than the reference papaverine [1].

Rutin, obtained from the plant *Sophora japonica*, markedly reduces the infarct size and prevented the loss of the ‘R’ wave in anaesthetized rats subjected to coronary artery ligation. It, however, had no effect on heart rate and systolic blood pressure. It also reduced the ligation induced increase in serum malonyldialdehyde levels and prevented the loss of glutathione peroxidase activity. Rutin inhibits, *in vitro*, luminol-induced chemiluminescence of rat PMN’s, thus indicating that its beneficial effect is probably due to its ability to impair the generation of reactive oxygen species [37].

Luteolin and α-G-rutin have been found to have protective effects on doxorubicin (DOX)-induced cardiotoxicity in mice [38]. In the heart, the lipid peroxide level increased to 1.5 times of the normal level induced by DOX was reported to decrease to the normal level after treatment with the said flavonoids. The application of the combined flavonoids was also shown to restore glutathione peroxidase (GSHpx) activity which decreased to 73 percent of normal activity after DOX treatment. Cholbi *et al*. [39] investigated antiperoxidative effects of a number of flavonoids using CCl_4-induced peroxidation of rat liver microsomes. Gardenin D, luteolin, apigenin, datiscetin, morin, eriodictyol and (+) catechin were reported to be the most potent flavonoids in this regard. A new acylated flavonol glycoside **163** along with four known flavonoid glycosides isolated from the methanol extract of *Hedyotis diffusa* showed antioxidant effects on xanthine oxidase, xanthine-xanthine oxidase cytochrome-c and TBA-MDA systems [40]. The vasodilator effects of the flavonoids, quercetin and its main metabolite isorhamnetin were analysed in isolated thoracic aorta, iliac artery and on the isolated perfused mesenteric resistance vascular bed from spontaneously hypertensive rats (SHR); both flavonoids were found to be potent in endothelium denuded aortae and iliac arteries [41]. The experimental results suggest the blood pressure reducing and vascular protective effects of quercetin in animal models of hypertension and possibly in human cardiovascular diseases.

Enzyme Inhibitory Activity

Flavonoids are known to inhibit a number of enzymes such as aldose reductase, xanthine oxidase, phosphodiesterase, Ca^{+2}-ATPase, lipo-oxygenase and cycloxygenase [42,43]. Flavones and flavonols with 3'-, 4'- and 7-hydroxyls are potent inhibitors of bovine pancreatic ribonuclease [44]. Methoxylation at the 6- and 8- positions decreases the inhibitory activity. Flavonols like quercetin, myricetin and kaempferol inhibit the activity of the adenosine deaminase of endothelial cells, while flavones have been found to be inactive [45]. Quercetin, morin, myricetin and kaempferol are effective in antagonizing bradykinin responses [46]. Luteolin and quercetin were reported to have effects on the inhibition of tyrosine kinase, cell growth and metastasis [47]. They have also inhibitory properties on the 5'-nucleotidase (5'-ribonucleotide phosphohydrolase) activity [48]. Apigenin inhibits phosphodiesterase (PDE) and the effect was greater on cAMP-PDE than cGMP-PDE levels by 40 percent and cGMP level remained unchanged. Thus the cardiotonic action appears to be due to the inhibition of cardiac cAMP-PDE [49,50]. Very recently Kim *et al*. [51] have reported significant inhibory effects of flavonols such as quercetin, reyneutrin, quercitrin, isoquercitrin and avicularin on rat lens aldose reductase (AR) - of which the former two components are found to more potent, and are promising compounds for the prevention and/or treatment of diabetic complications. From the study of structure-activity relationships it has been suggested that flavonols having hydroxy groups at C-7 and/or a catechol moiety on the B-ring exhibit strong activity; further, flavonols with 3-*O*-monosaccharides would also show stronger inhibition than free ones.

The isolated flavonoids **21**, **23** and **131** isolated from *Duranta repens* were reported to exhibit enzyme inhibitory activity [52]. All these compounds were found to be active against prolyl endopeptidase (PEP). The compound **23** also showed strong inhibition activity against thrombin (IC_{50} = 665 μM). The prenylated flavonoids **21** and **131** showed IC_{50} values of 230 & 450 μM, respectively, while both of them were found to be inactive against thrombin. These compounds **21** and **131** may, therefore, be regarded to be the selective natural inhibitors towards PEP. Studies on the inhibitory activity of jaceosidine, eupafolin, luteolin, quercetin and apigenin were carried out by Lee *et al*. [53] on Mouse Brain Monoamine Oxidase (MAO). The potencies of the flavonoids for the MAO enzyme were found to be in the order of apigenin (IC_{50} =1.0 μM), quercetin (IC_{50} =12.5 μM), luteolin (IC_{50} =18.5 μM), jaceosidine (IC_{50} =19.0 μM) and eupafolin (IC_{50} =25.0 μM). Agullo *et al*. [54] also investigated the inhibitory action of a number of flavonoids of different chemical classes on phospatidylinositol-3-kinase alpha (PI-3-kinase-alpha) activity, an enzyme recently shown to play an important role in signal transduction and cell transformation. Of them, myricetin was found to be the most potent PI-3-kinase inhibitor (IC_{50} =1.8 μM), while luteolin and apigenin were also effective inhibitors, with IC_{50} values of 8 & 12 μM, respectively. Fistein and quercetin were also found to be significant inhibitors for epidermal growth factor receptor (EGF-R), intrinsic tyrosine kinase and bovine brain protein kinase C (PKC). At elevated doses, some of these flavonoids were found to cause significant inhibition of PKC and tyrosine kinase activity of EGF-R. It is thought that accumulation of glycated protein (advanced glycation end products, AGE) is one of the most likely candidates for the cause of diabetic complications. The flavonoids - rutin, isorhamnetin glycosides, quercetin glycosides and **222** - isolated from peanut skins, have also inhibitory activity on bovine serum albumin (BSA) glycation [12]; the IC_{50} values for the flavonoids are in the range of 10-100 μM.

Action on Hormones

Flavonoids have also been shown to possess regulatory activity on hormones, by binding to 17-β-hydroxy-steroid dehydrogenase, which regulates estrogen and androgen levels in humans and to 3-hydroxy-steroid dehydrogenase, which regulates progestin and androgen levels in human [55]. Quercetin, myricetin, rutin, kaempferol affect the transport, metabolism and action of thyroid hormones. They also are potent non-toxic ITH deiodinase inhibitors in microsomal membranes and intact rat hepatocytes. Myricetin, rutin, kaemphreol have specifically high affinity for LT4 binding to human TBPA and very poor inhibitors of T3 binding to the nuclear T3 receptor [56].

Cytotoxic Activity

Hakim *et al*. [57] isolated a new prenylated flavone, artoindonesianin-P, along with three known related compounds, artobiloxanthone, cycloartobiloxanthone and artonol-B, from the tree bark of *Artocarpus lanceifolius*. The cytotoxic activity of the isolated flavonoids were tested against cultured murine P388 leukemia cells using established protocols [58] and showed significant activity, IC_{50}=5.9,1.7,4.6 & >100 μg/mL, respectively.

Three flavonoids, **39-41** isolated from stem bark of *Murraya paniculata* L. also have been reported to show cytotoxic activity against CEM-SS cells (T-lymphoblastic leukemia) [59]. The flavonoids have IC_{50} values greater than 30 μg/mL. In comparison with the correlated crude extracts, the IC_{50} values of the pure compounds were less than those of the crude extracts, suggesting that the three isolated flavonoids were not potent cytotoxic agents. This may be due to the absence of hydroxyl groups in the isolated flavonoids. The flavonoid glycoside, theograndin, isolated from *Theobroma grandiflorum* has also been reported to show cytotoxic activity in the HCT-116 and SW-480 human colon cancer cell lines with IC_{50} values of 143 and 125 μM, respectively [60].

Anticancer and Antitumour Activities

Flavones as well as flavonols show significant anticancer and antitumour properties. Fotsis *et al*. [61] suggested that 3-hydroxyflavone, 3',4'-dihydroxyflavone, 2',3'-dihydroxy-flavone, fistein, apigenin and luteolin inhibit the proliferation of normal and tumor cells, as well as *in vitro* angiogenesis, at half maximal concentrations in the low micro molar range. Therefore, it has been suggested that flavonoids may contribute to the preventive effect of a plant-based diet on chronic diseases, including solid tumors. Evaluation of the *in vitro* anti-cancer effects of bioflavonoids, *viz*. quercetin, catechin, luteolin and rutin against human carcinoma of larynx (Hep-2) and sarcoma 180 (S-180) cell lines showed that only luteolin and quercetin inhibited the poliferation of the cells. Luteolin caused depletion of glutathione in the cells and a decline in DNA synthesis as seen by ^{3}H thymidine uptake studies, thus demonstrating its anti-cancer potential [62].

Flavonoids have a role in suppressing the enhancement of phospholipid metabolism by tumor promotors [63]. Quercetin inhibited the incorporation of [^{32}P] inorganic phosphate (^{32}Pi) into phospholipid of HeLa cells enhanced by 12-*O*-tetradecanoylphorbol-13-acetate (TPA), a potent tumor promotor. Among the flavonoids tested, luteolin was the most effective in inhibiting the action of TPA. These two flavonoids also inhibited enhancement of ^{32}Pi-incorporation into phospholipid by dihydroteleocidin B, another potent tumor promotor [63].

The effect of dietary supplementation of flavonoid compounds such as quercetin, rutin, luteolin and (+)-catechin on the incidence of fibrosarcoma induced by 20-methyl cholanthrene (20-MC) in male swiss albino mice was observed [64]. Subcutaneous injection of 20-MC produced 100 percent tumor incidence and the onset of tumor appeared within 7 weeks, while flavonoid-treated mice (1 percent quercetin and luteolin mixed diets) produced tumors in the 9th week and the tumor incidences in mice treated with quercetin and luteolin-mixed were 52 percent and 60 percent, respectively. Subcutaneous administration of 20-MC along with the flavonoid compounds (quercetin, luteolin) was found to have significant effect on tumor expression. The compounds rutin and (+)-catechin did not influence tumor expression in both experiments.

The inhibition of human preadipocyte aromatase enzyme activity by flavonoid-rich plant foods may contribute to reduction of estrogen-dependent disease, such as breast cancer [65]. Six flavonoid compounds were evaluated for their abilities to inhibit aromatic enzyme activity in a human preadipose cell culture system. The flavonoids coumestrol, luteolin and kaempferol decreased aromatase enzyme activity, with Ki values of 1.3, 4.8 and 27.2 mM, respectively. Flavonoids were also found to have an effect on DNA synthesis in estrogen-dependent (MCF-7) and independent (MDA-MB-231) human breast cancer cells [66]. Treatment for 24 hours with most of the tested flavonoids at 20-80 mM inhibited DNA synthesis in MDA-MB-231 cells. On the other hand biphasic effects were seen in MCF-7 cells. At 0.1-10 μM, coumestrol, genistein, apigenin, luteolin and kaempferol induced DNA synthesis 150-235 percent and at 20-29 μM, inhibited DNA synthesis by 50 percent. Treatment of MCF-cells for 10 days with genistein or coumestrol showed continuous stimulation of DNA synthesis at low concentration.

Fifty-six flavonoids were tested for their antimutagenic potencies with respect to mutagenicities induced by 2-nitrofluorene, 3-nitrofluoranthene and 1-nitropyrene in *Salmonella typhimurius* TA98 [67]. Among the flavonoids, the parent flavone and flavanones were inactive, but all flavones and many flavonoids with phenolic hydroxyl groups exerted antimutagenicity. Antimutagenic potency reached a maximum with the presence of four hydroxyl functions, as in luteolin and kaempferol, though the position of hydroxyls is also a determinant of antimutagenic potency. Methylation of phenolic hydroxyl groups, however, always reduces antimutagenicity. By means of bio-assay-guided separation methods, the cancer cell growth inhibitory constituents in the bark, stem and leaves of the Mauritus medicinal plant *Terminalia arjuna* (Combretaceae) were examined by Pettit *et al*. [68]. The cancer cell line active components were found to be gallic acid, ethyl gallate and the flavone, luteolin. Luteolin has a well-established record of inhibiting various cancer cell lines and may account for most of the rationale underlying the use of *T. arjuna* in traditional cancer treatments.

Antineoplastic Activity

Quercetin, kaempferol and catehin exhibit antineoplastic activity. Detailed studies revealed that quercetin shows a dose dependent inhibition of cell growth and colony formation [3,4]. Kaempferol and catechin have also been reported to suppress cell growth [69,70].

Anti-ulcer Activity

Many flavonoids possess antiulcerogenic activity. Quercetin, rutin and kaempferol administered intraperitoneally (75-100 mg/kg) inhibited dose-dependent gastric damage produced by acidified ethanol in rats [71]. The flavonoids, including morin and myricetin, when tested were found to inhibit the mucosomal content of platelet activating factor (PAF) in a dose-dependent manner suggesting that the protective role of these substances may be mediated by endogenous PAF [71]. Quercetin, kaempferol and rutin produced an inhibitory effect on intestinal function; their actions were mediated through α_2-adrenergic and calcium systems [72]. This result may show beneficial effects in diarrhoea and other intestinal secretions.

Anti-Inflammatory Activity

A number of flavonoids, hesperidin, apigenin, quercetin, gallic acid ethyl ester *etc*. were found to possess antiinflammatory activity [1]. Reddy *et al*. [73] compared the anti-inflammatory activities of quercetin, wogonin, nevadensin and quercetin pentamethyl ether on carrageenan-induced rat paw edema. Quercetin showed significant activity only at a dose of 150mg/kg, while wogonin, nevadensin and quercetin pentamethyl ether showed good activity at 75mg/kg. The compounds exhibited increase in activity with increase in methoxylation. Acacetin, administered orally to mice at 25-100mg/kg, decreased formalin-induced inflammation [74]. Parente *et al*. [75] isolated three flavonoids **159**, **233** and quercetin-3-*O*-neohesperidoside, all of which exhibit anti-inflammatory activity. This activity was examined on nitric oxide production by activated macrophages. Compounds **159** and **233** showed IC_{50} values higher than 100 μM, indicating slight inhibitory activity whereas the remaining one shows moderate inhibitory activity (IC_{50} = 55 μM). Recently, Yadava *et al*. [76] have reported a novel flavonol glycoside, 5,7,3',4'-tetrahydroxy-3-methoxyflavone-7-*O*-α-rhamnopyranosyl(1->3)-*O*-β-D-galactopyranoside, **242** possessing anti-inflammatory activity.

Effects on Blood Vessels

Quercetin and rutin are used as effective constituents of several pharmaceuticals used for treatment of capillary fragility and phlebosclerosis. The flavonoids tangeratin, hesperidin, quercetin and rutin have been found to reduce aggregation of horse erythrocytes. The decrease in blood cell aggregation produced by most of the flavonoids may account for the beneficial effects of these compounds, as reported, on abnormal capillary permeability and fragility - the reduction of disease symptoms and their protection against various traumas and stress [77]. It was observed that inhibition of capillary permeability and Arthus phenomenon is in the order of hesperitin> rutin>quercetin>naringenin>kaempferol [78-81]. The flavonoids 7-*O*-(β-hydroxyethyl) rutoside, (+)-catechol, trihydroethylrutoside were reported to increase the negative charge density of the blood vessel wall *in vitro* and were markedly antithrombogenic [82]. Other anti-aggregatory flavonoids are quercetin, 3-methyl quercetin, dihydroquercetin and toxerutin.

Anti-Hatching Activity

Flavonol-3-*O*-galloylglycosides - **224**, **225**, myricetin-3-*O*-(2''-*O*-galloyl)-α-rhamno- pyranoside and myricetin-3-*O*-(3''-*O*-galloyl)-α-rhamnopyranoside - isolated from the leaves of *Acacia confusa*, exhibited anti-hatching activity towards brine shrimp [83]. The investigators assayed each compound with brine shrimp to observe their relative toxicity evaluated as IC_{50} of 89, 50, 75 and 64 μg/mL, respectively.

Anti-Microbial Activity

Flavones and flavonols exhibit a variety of anti-microbial activities. Luteolin was reported to possess specific activity against the pathogenic bacterium *Neisseria gonorrhoeae* [64]. Chhabra *et al*. [84] isolated a pterocarpan derivative from *Tephrosia aequilata* and showed that the compound exhibits low activity against gram-positive bacteria, *Bacillus subtilis* and *Micrococcus lutea*. This compound is not active against the fungus, *Aspergillus niger* and the yeast, *Saccharomyces cervisiae*.

The flavones **32-34**, isolated from *Gnaphalium affine* D. Don showed insect antifeedant activity against the common cutworm and were regarded as one of the plant's defensive systems against *Phytophagous* insects along with woolly plant surfaces [85]. 3,5,4'-Trihydroxy-7,3'-dimethoxy-flavone-3-*O*-β-D-xylopyranosyl(1->2)-*O*-α-L-rhamno-pyrano-side **243** isolated from *Neptunia oleracea,* has been reported to show anti-fungal activity [86]. It has been found that flavonols are more active than flavones against simplex virus type 1 and the order of significance was established as galangin > kaempferol > quercetin [87]. Vrijsen *et al*. [88] suggested that quercetin exhibited anti-viral activity only when protected against oxidative degradation by ascorbate. The anti-viral activity of luteolin is comparable to that of ascorbate-stabilised quercetin. The same group also compared the anti-poliovirus activities of three flavonoids, quercetin, luteolin and 3-methyl quercetin and noted the last one as the most potent compound.

7-Hydroxy-3',4'-methylenedioxyflavone isolated from the fruit rind of *Terminalia beleri* has been found to possess demonstrable anti-HIV-1, anti-malarial and anti-fungal activity *in vitro* [89,90]. The flavone glycosides, 5,2'-dihydoxy-3,6,7-trimethoxy flavone-5-*O*-β-D-xylopyranosyl (1->4)–*O*-β-D-glucopyranoside [91] **81** and 5,7-dihydoxy-3,6,4'-tri- methoxyflavone-7-*O*-α-L-arabinopyranosyl(1->4)–*O*-α-L-rhamnopyranosyl(1->3)-*O*-β-D-xylopyranoside [92] **82** isolated from *Butea monosperma,* have been reported to show anti-viral activity. Recently Yenjai *et al*. [93] reported that the flavones, 5,7,4'-trimethoxyflavone and 5,7,3',4'-tetramethoxyflavone, isolated from *Kaempferia parviflora* exhibited antiplasmodial activity against *Plasmodium falciparum* with IC_{50} values of 3.70 and 4.06 μg/mL respectively; 3,5,7,4'-tetramethoxyflavone and also the former one showed antifungal potential against *Candida albicans* with respective IC_{50} values of 39.71 and 17.63 μg/mL. Nevadensin and isothymusin, both exhibit inhibition activity also against *Mycobacterium tuberuculosis*, with an equal MIC value of 200 μg/mL [9].

Anti-HIV Activity

Lee *et al*. [94] isolated a new flavonoid, apigenin-7-*O*-β-D-(4'-caffeoyl) glucuronide, from *Chrysanthemum morifolium*, which shows strong HIV-1 integrase inhibitory activity (IC_{50}=7.2+-3.4 μg/mL) and anti-HIV activity in a cell culture assay (EC_{50}=41.86+-1.43 μg/mL) using HIV-1 IIIB infected MT-4 cells.

Anti-Histaminic Activity

Tricin (5,7,4'-trihydroxy-3',5'-dimethoxyflavone) shows potent antihistaminic activity. Otsuka *et al*. [95] have recently reported that tricin obtained from bioassay-guided separation of *Agelaea pentagyna* exhibits inhibitory activity towards exocytosis from antigen-stimulated rat leukemia basophils (RBL-2H3).

THERAPEUTIC EFFICACY

Nowadays, it is well known that bioflavonoids possess immense therapeutic potential. In view of the need for safe and effective medicines, natural flavonoids have been examined against numerous diseases and the experimental results obtained so far have already established many flavonoids as satisfactory treatments for various ailments. A few of them are recorded in Table **1**.

RECENTLY REPORTED FLAVONES AND FLAVONOLS

The naturally occurring flavones and flavonols reported during the period mid-1999 to early 2004 are presented in Table-**2**. Structures of the flavones are shown in Fig. **1** and those of flavonols in Fig. **2**.

Fifty-two plant families are listed in Table **2** as natural sources of flavones and flavonols reported during the period of review. A major part of these flavonoids originate from three families − Fabaceae (Papilionaceae, Mimosaceae, Leg

Table 1. Diseases treated with flavonoids

Flavonoid	Disease	Reference
Quercetin, hydroxyethylrutosides	Pain and inflammation, night cramps. Odema, ankle/leg circumference	96, 97
Quercetin	Allergy	98
Quercetin	Oral surgery, stomach headache, duodenal ulcers	3, 96, 99
Quercetin	Diabetes mellitus	42
Quercetin	Parodentosis	97
Quercetin	Cancer	3-5
Rutin	Allergy	100-103
Quercetin, rutin,kaempferol	Ulcer	4
Quercetin	Virus infection, common cold and chemical oncogenesis	100-103

Table 2. Naturally-occurring new flavones and flavonols reported during the period mid-1999 to early 2004

Family	Genus	Species	Flavones and Flavonols	Ref.
Acanthaceae	*Andrographis*	*viscosula* (whole plant)	5,7,2'-trimethoxyflavone(**18**)	104
	Andrographis	*viscosula* (whole plant)	5,7,2',4',6'-Pentamethoxy flavone(**19**)	104
	Andrographis	*elongata* (whole plant)	Skullcapflavone-2'-*O*-β-D-(4''-*E*-cinnamyl) glucopyranoside (**65**)	105
Amaranthaceae	*Blutaparon*	*portulacoids* (aerial parts)	3,5,3'-Trihydroxy-4'-methoxy-6,7-methylenedioxyflavone (**135**)	106
Anacardiaceae	*Sclerocarya*	*birrea*	Quercetin-3-*O*-α-L-(5''-galloyl)-arabinofuranoside (**211**)	107
Araceae	*Anthurium*	*versicolor* (leaves)	Acacetin-6-*C*-{α-L-rhamno-pyranosyl-(1→3)}-β-D-gluco-pyranoside (**98**)	16
	Anthurium	*versicolor* (leaves)	Acacetin-6-*C*-{β-D-apiofuranosyl-(1→3)}-β-D-glucopyranoside (**99**)	16
	Anthurium	*versicolor* (leaves)	Acacetin-8-*C*-{α-L-rhamnopyranosyl-(1→3)-β-D-xylopyranosyl(1→6)}-β-D-glucopyranoside (**100**)	16
	Anthurium	*versicolor* (leaves)	Acacetin-6-*C*-{β-D-glucopyranoside}(**101**)	16
Bombacaceae	*Duroia*	*hirsuta* (roots)	3,7,3',5'-Tetramethoxy-4'-hydroxy flavone (**3**)	108
	Duroia	*hirsuta* (roots)	3,7,3'-Trimethoxy-4',5'-dihydroxy flavone (**4**)	108
	Duroia	*hirsuta* (roots)	7,3',5'-Trimethoxy-3,4'-dihydroxyflavone (**132**)	108
	Elsholtzia	*stauntonii*	5-Hydroxy-7,5'-dimethoxy-6,8-dimethyl-3',4'-methylenedioxyflavone (**11**)	109
	Elsholtzia	*stauntonii*	5-Hydroxy-7-methoxy-8-methyl-5'-(3-methylbut-2-enyl)-3',4'-methylenedioxy flavone (**12**)	109
Asteraceae (Compositae)	*Grangea*	*maderaspatana* (aerial parts)	5,3'-Dihydroxy-3,6,7,4',5'-pentamethoxy flavone (**14**)	110
	Grangea	*maderaspatana* (aerial parts)	5,4'-Dihydroxy-3,6,7,3',5'-pentamethoxy flavone (**15**) (Murrayanol)	110
	Grangea	*maderaspatana* (aerial parts)	5-Hydroxy-3,6,7,3',4',5'-hexamethoxy flavone (**16**)	110
	Gnaphalium	*affine* (cudweed)	5-Hydroxy-3,6,7,8,4'-pentamethoxy flavone (**32**)	85
	Gnaphalium	*affine* (cudweed)	5-Hydroxy-3,6,7,8,-tetramethoxy flavone (**33**)	85
	Gnaphalium	*affine* (cudweed)	5,6-Dihydroxy-3,7-dimethoxy flavone (**34**)	85
	Lagopsis	*supine*	Apigenin-7-*O*-(3'',6''-di-(*E*)-*p*-coumaroyl)-β-D-galactopyranoside (**120**)	111
	Lagopsis	*supine*	Apigenin-7-*O*-(6''-(*E*)-*p*-coumaroyl)-β-D-galactopyranoside (**121**)	111
	Psiadia	*punetulata* (leaves)	5,7-Dihydroxy-2',3',4',5'-tetramethoxy flavone (**27**)	112

(Table 2) contd…..

Family	Genus	Species	Flavones and Flavonols	Ref.
	Psiadia	*punetulata* (leaves)	5,4'-Dihydroxy-7,2',3',5'-tetramethoxy flavone (**28**)	112
	Psiadia	*punetulata* (leaves)	5,7,4'-Trihydroxy-2',3',5'-trimethoxy flavone(**29**)	112
	Tridax	*procumbens* (aerial parts)	3,6-Dimethoxy-5,7,2',3',4'-pentahydroxy-flavone-7-*O*-β-D-glucopyranoside (**73**)	113
	Centaurea	*bracteata* (aerial parts)	Centabractein (**66**)	114
`	*Centaurea*	*bracteata* (aerial parts)	Bracteoside (**67**)	114
	Centaurea	*horrida* (aerial parts)	Quercetin-3-*O*-α-L-rhamnopyranosyl(1→2)-α-L-rhamnopyranoside (**201**)	115
	Chrysanthemum	*viscidehirtum* (aerial parts)	2''-glucosyl-8-*C*-glucosyl-4'-*O*-methylapigenin (**122**)	116
	Silphium	*perfoliatum* (leaves)	Kaempferol-3-*O*-β-D-apiofuranoside-7-*O*-α-L-rhamnosyl(1''''→6''')-*O*-β-D-galactopyranoside (**142**)	117
	Silphium	*perfoliatum* (leaves)	Kaempferol-3-*O*-β-D-apiofuranoside-7-*O*-α-L-rhamnosyl(1''''→6''')-*O*-β-D-(2'''-*O*-*E*-caffeoyl galactopyranoside (**143**)	117
	Felicia	*amelloides* (flower petals)	Swertisin 2''-*O*-rhamnoside-4'-glycoside (**90**)	118
	Leuzea	*carthamoides* (roots)	Quercetin-5-*O*-galactoside (**207**)	119
	Leuzea	*carthamoides* (roots)	Isorhamnetin-5-*O*-rhamnoside (**212**)	119
	Tanacetum	*gracile* (aerial parts)	5,6'-Dihydroxy-3',6,7-trimethoxy flavone (**1**)	120
	Tanacetum	*gracile* (aerial parts)	3,5-Dihydroxy-6,7,3'-trimethoxyflavone (**133**)	120
Caryophyllaceae	*Drymaria*	*diandra* (whole plant)	6-*Trans*-{2''-*O*-(α-rhamno pyranosyl)}-ethenyl- 5,7,4'-trihydroxyflavone (**88**)	121
	Scleranthus	*uncinatus*	5,7,4'-Trihydroxy-3'-methoxyflavone-8-*C*-β-D-xylopyranoside-2''-*O*- glucoside (**84**)	122
	Scleranthus	*uncinatus*	5,7-Dihydroxy-3'-methoxy 4'-acetoxyflavone-8-*C*-β-D-xylopyranoside-2''-*O* glucoside (**85**)	122
	Maytenus	*aquifolium* (leaves)	Kaempferol-3-*O*-α-L-rhamnopyranosyl (1→6)-*O*-{α -L-arabinopyranosyl (1→3)-*O*-α -L-rhamnopyranosyl (1→2)-*O*-β-D-galactopyranoside (**152**)	123
Cucurbitaceae	*Cucumis*	*sativus* (leaves)	Isoscoparin-2''-*O*-(6'''-(*E*)-*p*-coumaroyl) glucoside (**102**)	124
	Cucumis	*sativus* (leaves)	Isoscoparin-2''-*O*-(6'''-(*E*)-*p*-feruloyl) glucoside-4'-*O*-glucoside (**103**)	124
	Cucumis	*sativus* (leaves)	Isovitexin-2''-*O*-(6'''-(*E*)-*p*-coumaroyl) glucoside (**104**)	124
	Cucumis	*sativus* (leaves)	Isovitexin-2''-*O*-(6'''-(*E*)-*p*-coumaroyl) glucoside-4'-*O*-glucoside (**105**)	124
	Cucumis	*sativus* (leaves)	Isovitexin-2''-*O*-(6'''-(*E*)-*p*-feruloyl) glucoside-4'-*O*-glucoside (**106**)	124
	Morettia	*philaena*	Kaempferol-3-*O*-β-D-glucopyranoside (**140**)	129
	Morettia	*philaena*	Kaempferol-3-*O*-{2''-(6'''-*p*-coumaroyl-β-D-glucopyranosyl)-α-L-arabinopyranosyl}-7-*O*−β-D-glucopyranoside (**160**)	125
	Morettia	*philaena*	Quercetin-3-*O*-{2''-(6'''-*p*-coumaroyl-β-D-glucopyranosyl)-α-L-arabinopyranosyl}-7-*O*-β-D-glucopyranoside (**192**)	125
Convolvulaceae	*Ipomoea*	*fistulosa* (leaves)	Quercetin-3-galactosyl(6'→1'')-rhamnoside (**189**)	126
	Ipomoea	*fistulosa* (leaves)	Quercetin-3-galactoside (**190**)	126
	Ipomoea	*fistulosa* (leaves)	Quercetin-3-glucoside (**191**)	126

(Table 2) contd…..

Family	Genus	Species	Flavones and Flavonols	Ref.
	Cuscuta	*reflexa* (stems)	Kaempferol-3-*O*-α-rhamnoside (**168**)	126
Capparidaceae	*Capparis*	*spinosa* (aerial parts)	Quercetin-3-*O*-{6"-α-L-rhamnosyl-6"-β-D-glucosyl}-β-D-glucoside (**202**)	127
Chenopodiaceae	*Chenopodium*	*murate*	Kaempferol-3-*O*-{(4-β-D-apiofuranosyl)-α-L-rhamnopyranoside}-7-*O*-α-L- rhamnopyrano-side (**175**)	128
	Chenopodium	*murate*	Kaempferol-3-*O*-{(4-β-D-xylopyranosyl)-α-L-rhamnopyranoside}-7-*O*-α-L- rhamnopyranoside (**176**)	128
	Hammada	*scoparia* (leaves)	Isorhamnetin-3-β-D-xylopyranosyl (1""→3"')-α-L-rhamnopyranosyl (1"'→6")-β-D-galacto pyranoside (**217**)	129
Crassulaceae	*Orostachys*	*japonicus* (aerial parts)	Gossypetin-8-*O*-α -D-lyxopyranoside (**238**)	130
Brassicaceae (Cruciferae)	*Arabidopsis*	*thaliana* (leaves)	Kaempferol-3-*O*-β-{β-D-glucopyranosyl (1→6)-D-gluco pyranoside}-7-*O*-α-L-rhamnopyranoside (**154**)	131
	Arabidopsis	*thaliana* (leaves)	Kaempferol-3-*O*-β-D-glucopyranoside-7-*O*-α-L-rhamnopyranoside (**155**)	131
	Arabidopsis	*thaliana* (leaves)	Kaempferol-3-*O*-α-L-rhamno pyranoside-7-*O*-α-L-rhamnopyranoside (**156**)	131
	Carrichtera	*annua* (whole plants)	Quercetin-3-*O*-{(6-feruloyl-β-glucopyranosyl)-(1→2)- β -arabinopyranoside}-7-*O*-β -gluco-pyranoside (**186**)	132
	Comptonilla	*microcarpa* (leaves)	7-Hydroxy-3,5,6,8-tetramethoxy-3',4'-methylene dioxyflavone (**54**)	133
	Comptonilla	*microcarpa* (leaves)	7-(3-Methyl but-2-enyloxy)- 3,5,6,8-tetramethoxy-3',4'-methylenedioxy flavone (**55**)	133
	Brassica	*juneea* (leaves)	Isorhamnetin-3,7-di-*O*-β-D-glucopyranoside (**221**)	134
Guttiferae (Clusiaceae)	*Mammea*	*longifolia* (buds)	Quercetin-3-*O*-(2",4"-di-*E*-*p*-coumaroyl)-α-L-rhamnopyranoside (**179**)	135
	Mammea	*longifolia* (buds)	Quercetin-3-*O*-(3",4"-di-*E*-*p*-coumaroyl)-α-L-rhamnpyranoside (**180**)	135
Dipsacaceae	*Morina*	*napalensis* (whole plants)	Quercetin-3-*O*-{2""-*O*-(*E*)-caffeoyl}-α-L-arabinosyl(1→6)- β-D-galactopyranoside (**183**)	136
Dipterocarpaceae	*Shorea*	*robusta* (seeds)	3,7-Dihydroxy-8-methoxyflavone-7-*O*-α-L-rhamnopyranosyl(1→4)-α-L-rhamnopyranosyl(1→6)-β-D-glucopyranoside (**239**)	137
Euphorbiaceae	*Daphniphyllum*	*calycinum* (leaves)	5,6,7,4'-Tetrahydroxyflavonol-3-*O*-rutinoside (**245**)	13
Fagaceae	*Quercus*	*semicarpifolia*	5-Acetoxy-3,3',4',5'-tetramethoxyflavone (**13**)	138
	Quercus	*dentate* (leaves)	Kaempferol-3-*O*-{2"-*O*-(*trans*-*p*-coumaroyl)-6"-*O*-acetyl}-β-D-glucopyranoside (**170**)	139
	Quercus	*dentate* (leaves)	Kaempferol-3-*O*-{2",6"-di-*O*-(*trans*-*p*-coumaroyl)-3',4"'-di-*O*-acetyl}-β-D-glucopyranoside (**171**)	139
	Quercus	*dentate* (leaves)	Kaempferol-3-*O*-{6"-*O*-(*trans*-*p*-coumaroyl)}-β-D-glucopyranoside (**172**)	139
Geraniaceae	*Pelargonium*	*reniforme* (aerial parts)	Isoorientin -2"-*O*-galloyl glucoside (**107**)	141
	Pelargonium	*reniforme (aerial parts)*	Isovitexin -2"-*O*-galloyl glucoside (**108**)	141
	Pelargonium	*reniforme* (aerial parts)	Vitexin -2"-*O*-galloyl glucoside (**109**)	141
	Pelargonium	*reniforme* (aerial parts)	Orientin -2"-*O*-galloyl glucoside (**110**)	141
Ginkgoaceae	*Glnkgo*	*biloba* (leaves)	Kaempferol-3-*O*-α-L-{6"-*p*-coumaroyl-β-D-glucopyranosyl (1→2)-rhamnopyranoside-7-*O*-β-D-glucopyranoside (**146**)	15
	Glnkgo	*biloba* (leaves)	Isorhamnetin-3-*O*-α-L-{6"-*p*-coumaroyl-β-D-glucopyranosyl (1→2)-rhamnopyranoside (**213**)	15
	Glnkgo	*biloba* (leaves)	Kaempferol-3-*O*-β-D-glucoside (**164**)	142
	Glnkgo	*biloba* (leaves)	Kaempferol-3-*O*-β-D-glucosyl (1→2)- α-L-rhamnoside (**165**)	142

(Table 2) contd…

Family	Genus	Species	Flavones and Flavonols	Ref.
	Glnkgo	*biloba* (leaves)	Kaempferol-3-*O*-β-D-rutinoside (**166**)	142
	Glnkgo	*biloba* (leaves)	Quercetin-3-*O*-β-D-glucoside (**195**)	142
	Glnkgo	*biloba* (leaves)	Quercetin-3-*O*-β-D-glucosyl (1→2)-α-L-rhamnoside (**196**)	142
	Glnkgo	*biloba* (leaves)	Isorhamnetin-3-*O*-β-D-rutinoside (**219**)	142
	Glnkgo	*biloba* (leaves)	Isorhamnetin-3-*O*-β-D-glucosyl (1→2)-α-L-rhamnoside (**220**)	142
Iridaceae	*Iris*	*bungei*	5,7,2'-Trihydroxy-3,6-dimethoxy flavone (**35**)	143
	Iris	*bungei*	5,2'-Dihydroxy-3,6,7-trimethoxy flavone (**36**)	143
	Iris	*bungei*	5,2',6' -Trihydroxy-3,6,7-trimethoxy flavone (**37**)	143
	Iris	*bungei*	3,5,3'-Trihydroxy-7,2'-dimethoxy flavone (**130**)	143
	Iris	*carthaliniae (*rhizomes)	6,4'-Dimethoxy-5-hydroxyflavone-7-*O*-glycoside (**80**)	144
Fabaceae (Papilionaceae, Mimosaceae, Leguminosae, Caesalpiniaceae)	*Cassia*	*occidentalis* (aerial parts)	Cassiaoccidentalins A (**68**)	145
	Cassia	*occidentalis* (aerial parts)	Cassiaoccidentalins B (**69**)	145
	Cassia	*occidentalis* (aerial parts)	Cassiaoccidentalins C (**70**)	145
	Cassia	*fistula* (defatted seeds)	5,3',4'-Trihydroxy-6-methoxy-7-*O*-α-L-rhamnopyranosyl (1→2)-*O*-β-D-galactopyranoside (**77**)	146
	Cassia	*marginata* (stem)	Kaempferol-3-*O*-α-L-rhamnopyranosyl (1→2)-β-D-glucopyranosyl (1→6)-β-D-galactopyranoside (**145**)	147
	Cassia	*marginata* (stem)	Quercetin-3-*O*-α-L-rhamnopyranosyl (1→2)-β-D-glucopyranosyl (1→6)-β-D-galactopyranoside (**185**)	147
	Bauhinia	*variegata* (seeds)	5-Hydroxy-7,3',4',5'-tetramethoxyflavone-5-*O*-β-D-xylopyranosyl (1→2)-α-L-rhamno-pyranoside (**72**)	148
	Bauhinia	*variegata* (seeds)	5,7,3',4'-Tetrahydroxy-3-methoxyflavone-7-*O*-α-rhamnopyranosyl-(1→3)-*O*-β-D-galactopyranoside (**242**)	76
	Bauhinia	*purpurea* (stem)	5,6-Dihydroxy-7-methoxy flavone-6-*O*-β-D-xylopyranoside (**83**)	149
	Bowdichia	*virgilioides* (roots)	3,6-Dimethoxy-6",6"-dimethylchromene- (7,8,2",3") flavone (**60**)	150
	Arachis	*hypogaea*	Isorhamnetin-3-*O*-[2-*O*-β-glucopyranosyl-6-*O*-α-rhamnopyranosyl]-β-glucopyranoside (**222**)	12
	Albizia	*odoratissima* (root bark)	7,2',4'-Trimethoxyflavone (**20**)	151
	Albizia	*odoratissima* (root bark)	7,8-Dimethoxy-3',4'-methylene dioxyflavone (**51**)	151
	Acacia	*catechu* (stems)	5,7,3',4'-Tetrahydroxy-3-methoxyflavone-7-*O*-β-D-galactopyranosyl (1→4)-*O*-β−D-glucopyranoside (**78**)	152
	Acacia	*confusa* (leaves)	Myricetin-3-*O*-(2"-*O*-galloyl)-α-rhamnopyranoside-7-methyl ether (**224**)	83
	Acacia	*confusa* (leaves)	Myricetin-3-*O*-(2",3"-di-*O*-galloyl)-α-rhamnopyranoside (**226**)	83
	Pithecellobim	*dulce* (fruits)	3'-Prenylapigenin-7-*O*-α-L-rhamnopyranosyl-(1→6)-*O*-β-D-glucopyranoside (**123**)	153
	Neptunia	*oleracea* (seeds)	3,5,4'-Trihydroxy-7,3'-dimethoxyflavone-3-*O*-β-D-xylopyranosyl (1→2)-*O*-α-L-rhamno-pyranoside (**243**)	86
	Butea	*monosperma* (flowers)	5,2'-Dihydroxy-3,6,7-trimethoxy flavone-5-*O*-β-D-xylopyranosyl (1→4)-*O*-β-D-glucopyranoside (**81**)	91

(Table 2) contd…..

Family	Genus	Species	Flavones and Flavonols	Ref.
	Butea	*monosperma* (flowers)	5,7-Dihydroxy-3,6,4'-trimethoxy flavone-7-*O*-α-L-arabinopyranosyl (1→4)-*O*-α-L-rhamnopyranosyl (1→3)-*O*-β-D-xylopyranoside (**82**)	92
	Butea	*monosperma* (flowers)	3,7,4'-Trihydroxyflavone (**134**)	154
	Retama	*ractam* (aerial parts)	5,4'-Dihydroxy-(3",4"-dihydro-3",4"-dihydroxy)-2",2"-dimethyl pyrano(5",6",7,8) flavone (**63**)	155
	Retama	*ractam* (aerial parts)	Luteolin-4'-*O*-neohesperidoside (**116**)	155
	Retama	*sphaerocarpa* (aerial parts)	Rhamnazin-3-*O*-β-D-gluco pyranosyl(1->5){β-D-apiofurano syl(1→2)}-α-L-arabinofuranoside [Retamatrioside] (**237**)	156
	Lonchocarpus	*latifolius* (roots)	3,5-Dimethoxy-2",2"-dimethyl-pyrano (5",6",7,8) flavone (**59**)	157
	Dalbergia	*sympathelica* (stems)	5,7-Dihydroxy-4'-methoxyflavone-5-*O*-α-L-rhamnopyranosyl(1→6)-*O*-β-D-galactopyranoside (**89**)	158
	Lotus	*polyphyllos* (whole plant)	Kaempferol-3-*O*-β-(6"-O-E-p-coumaroyl glucoside)-7-O-β-glucoside (**141**)	159
	Lotus	polyphyllos (whole plant)	Quercetin-3-O-β-(6"-O-E-p-coumaroylglucoside)-7-O-β-glucoside (**178**)	159
	Lotus	polyphyllos (whole plant)	Isorhamnetin-3-O-β-(6"-O-E-p-coumaroyl glucoside)-7-O-β-glucoside (**215**)	159
	Lotus	*garcinii*	3-O-(3"-O-α-L-rhamnopyranosyl)-β-L- rhamnopyranosyl kaempferol [Garcintin](**153**)	160
	Astragalus	*skikokianus* (aerial parts)	Kaempferol-3-*O*-α-L-rhamno pyranosyl (1→6){α-L-rhamno pyranosyl (1→2)}-β-D-galacto pyranosyl-7-*O*- α -L-rhamno pyranoside (**161**)	161
	Astragalus	*caprinus* (leaves)	Kaempferol-3-*O*-{β-D-xylopyranosyl(1-3)-α-L-rhamnopyranosyl(1→6)-α-L- rhamnopyrano-syl(1→2)}-β-D-galactopyranoside (**144**)	162
	Astragalus	*vulneraria* (aerial parts)	Isorhamnetin-3-*O*-β-D-apiofurasyl (1→2)-α-L-rhamnopyranosyl(1→6)-β-D-galactopyranoside (**216**)	163
	Trigonella	*foenumgraecum* (stems)	Kaempferol-3-*O*-β-D-glucosyl (1→2)-β-D-galactoside-7-*O*-β-D-glucoside (**150**)	164
	Trigonella	*foenumgraecum* (stems)	Kaempferol-3-*O*-β-D-glucosyl(1→2)-(6"-*O*-acetyl)-β-D-galactoside-7-*O*-β-D-glucoside (**151**)	164
	Trigonella	*foenumgraecum* (stems)	Quercetin-3-*O*-β-D-glucosyl(1→2)-β-D-galactoside-7-*O*-β-D-glucoside (**181**)	164
	Vicia	*amurenis*	Quercetin-3-*O*-α-L-(3-feruloylrhamnopyrano-syl)(1→6){α-L-rhamnopyranosyl(1→2)}-β-D-galactopyrano side[Amurenosides A] (**197**)	165
	Vicia	*amurenis*	Quercetin-3-*O*-α-L-(2-feruloylrhamnopyranosyl)(1→6){α-L-rhamnopyranosyl(1→2)}-β-D-galactopyrano side[Amurenosides B](**198**)	165
	Pongamia	*pinnata*	3',4'-Dimethoxy (2",3",7,8) furanoflavone (**127**)	166
	Pongamia	*pinnata*	3,5,3',4'-Tetrahydroxy-7-methoxyflavone-3-*O*-{α-L-arabinopyranosyl(1→3)}{β-D-galactopyranosyl(1→6)-β-D-galactopyranoside (**240**)	167
	Milletia	*lauretti* (heart wood)	3,7,4'-Trihydroxy-3',5'-dimethoxyflavone [Laurentirol] (**136**)	168
	Glochidion	*zeylanicym* (leaves)	(2*R*, 3*S*)-3,7,4'-Trihydroxy-5,3'-dimethoxyflavan-7-*O*-β-D-glucopyranoside[Glochiflavanoside A](**246**)	169
	Glochidion	*zeylanicym* (leaves)	(2R,3S)-3,7,4'-Trihydroxy, 5,3',5'-trimethoxyflavan-7-*O*-β-D-glucopyranoside [Glochiflavanoside B](**247**)	169
	Glochidion	*zeylanicym* (leaves)	(2*R*,3*S*)-3,7,4'-Trihydroxy-5,3',5'-trimethoxyflavan-4'-*O*-β-D-glucopyranoside [Glochiflavanoside C](**248**)	169
	Glochidion	*zeylanicym* (leaves)	(2*R*,3*S*)-3,7,4'-Trihydroxy-5,3'-dimethoxyflavan-3-*O*-β-D-glucopyranoside [Glochiflavanoside D] (**249**)	169

(Table 2) contd…..

Family	Genus	Species	Flavones and Flavonols	Ref.
	Mundulea	*suberosa*	5-Methyl lupinifolinol	170
Liliaceae	*Polygonum*	*capitatum*	3',4'-Methylenedioxy-3,5,6,7,8,5'-hexamethoxyflavone (**52**)	171
	Polygonum	*aviculare*	5,3'-Dihydroxy-4'-*O*-angeloxy flavone-7-*O*-β-D-glucopyrano side (**87**)	172
	Polygonum	*viscosum* (whole plants)	Quercetin-3-*O*-(6''-affeoyl)-β-D-galacto pyranoside (**199**)	173
	Allium	*cepa* (bulb stems)	Quercetin-3'-methoxy-4'-*O*-β-D-glucopyranoside (**209**)	174
Lobeliaceae	*Pratia*	*nummularia* (aerial parts)	Luteolin-7-*O*-rutinoside (**114**)	175
	Pratia	*nummularia* (aerial parts)	Apigenin-7-*O*-rutinoside (**118**)	175
Lamiaceae (Labiatae)	*Salvia*	*moorcroftiana* (aerial parts)	5,7,4'-Trihydroxy flavone (**7**)	176
	Salvia	*moorcroftiana* (aerial parts)	5,3',4'-Trihydroxy flavone (**8**)	176
	Salvia	*moorcroftiana* (aerial parts)	5,3'-Dihydroxy-6,7,4'-trimethoxy flavone (**9**)	176
	Scutellaria	*planipes* (roots)	5,7,3',6'-Tetrahydroxy-6,8,2'-trimethoxy flavone (**25**)	177
	Scutellaria	*planipes* (roots)	7,2'-Dihydroxy-5-methoxy flavone(**26**)	177
	Scutellaria	*radix* (roots)	5,7,2',6'-Tetrahydroxy-8-methoxy flavone(**30)**	178
	Scutellaria	*immaculate* (aerial parts)	5,8-Dimethoxy-7-*O*-β-D-gluco pyranosylflavone[Immaculoside](**76**)	179
	Ocimum	*americanum* (leaves)	5,4'-Dihydroxy-6,7,8-trimethoxy flavone (**22**)	180
	Ocimum	*americanum* (leaves)	5,7,8-Trihydroxy-6,4'-dimethoxy flavone(**31)** (Pilosin)	180
	Ocimum	*americanum* (leaves)	5,4'-Dihydroxy-6,7,3'-trimethoxy flavone (**38**)	180
	Mentha	*longifolia* (essential oil)	5,7,4'-Trihydroxy-6,2',3' trimethoxyflavone (**42**)	181
	Mentha	*lavandulacea* (aerial parts)	Kaempferol-3-*O*-glucosyl(1->2)-rhamnoside-7-*O*-glucoside (**147**)	182
	Mentha	*lavandulacea* (aerial parts)	Kaempferol-3-*O*-(6''-*p*-coumaroylglucosyl)(1→2)-rhamnoside-7-*O*-glucoside (**148**)	182
	Mentha	*lavandulacea* (aerial parts)	Kaempferol-3-*O*-(4''-*p*-coumaroylglucosyl)(1→2)-rhamnoside-7-*O*-glucoside (**149**)	182
	Elsholtzia	*blanda* (whole parts)	5,5'-Dihydroxy-6,7-methylene dioxy-8,3'',3''-trimethylpyran [3',4'] flavone(**56**)	183
	Elsholtzia	*blanda* (whole parts)	5,5'-Dihydroxy-7-acetoxy-6,8,3'',3''-tetramethyl-pyran (3',4') flavone (**57**)	183
	Elsholtzia	*blanda* (whole parts)	5,5'-Dihydroxy-7-(α-methylbutyroxyl)-6,8,3'',3''-tetramethylpyran(3',4') flavone (**58**)	183
	Melissa	*officinalis* (leaves)	Luteolin-3'-*O*-β-D-glucoronide (**115**)	184
Lauraceae	*Persea*	*gratissima* (flowers)	3-*O*-*Trans*-*p*-coumaroyl kaempferol (**167**)	185
	Persea	*gratissima* (flowers)	Quercetin-3-*O*-rutinoside (**194**)	185
	Persea	*gratissima* (flowers)	Isorhamnetin-3-*O*-glucoside (**214**)	185
Malvaceae	*Neoraputia*	*magnifica* (fruits)	5,7,3',4',5'-Pentamethoxy flavone (**17**)	186
	Neoraputia	*magnifica* (fruits)	5,6,7-Trimethoxy-3',4'-methylenedioxy-flavone (**44)**	186
	Neoraputia	*magnifica* (fruits)	5,6,7,5'-Tetramethoxy-3',4'-methylenedioxy-flavone (**45**)	186

(Table 2) contd…..

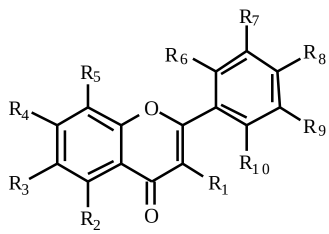
Family	Genus	Species	Flavones and Flavonols	Ref.
	Neoraputia	*magnifica* (fruits)	3',4'-Methylenedioxy-5,7-dimethoxy flavone (**49**)	186
	Neoraputia	*paraensis* (aerial parts)	5,7,5'-Trimethoxy-6- (3''-hydroxy-3''-methyl –*trans* –but–1''–enyl) -3',4'-methylenedioxy flavone (**53**)	187
	Neoraputia	*paraensis* (aerial parts)	5,4'-Dihydroxy-3',5'-dimethoxy-6,7-(2'',2''-dimethyl pyran) flavone(**61**)	187
	Neoraputia	*paraensis* (aerial parts)	5,4'-Dihydroxy-8,3',5'-trimethoxy-6,7-(2'',2''-dimethyl pyran) flavone(**62**)	187
Moraceae	*Dorstenia*	*dinklagei* (twings)	(+)-6-(2-Thetahydroxy-3-methyl-3 butenyl-5,7,4'-trihydroxyflavone [Dinklagins C](**43**)	188
	Dorstenia	*dinklagei* (twings)	(+)-5,4',5'-Thetatrihydroxy-6'',6''-dimethyl-chromano(7,6,2'',3'')flavone [Dinklagins B] (**64**)	188
Monimiaceae	*Siparuna*	*apiosyce* (leaves)	3,7-Di-*O*-methyl-4'-*O*-β-{α-rhamnosyl (1->6)} glucopyranoside[Siparunoside] (**244**)	189
Myrtaceae	*Metrosideros*	*robusta* (leaf wax)	5,7-Dihydroxy-3,8,4'-trimethoxy-6-*C*-methylflavone (**24**)	190
	Eugenia	*jambolana* (leaves)	Myricetin-3-*O*-(4''-acetyl)-α-L- rhamnopyranoside (**223**)	191
	Eugenia	*jambolana* (leaves)	Myricetin-3-*O*-(4''-*O*-acetyl)-α-L-rhamnopyranoside [Myricetin-4'-methyl ether (**229**)	192
	Eugenia	*jambolana* (leaves)	Myricetin-3-*O*-(4''-*O*-acetyl-2''-*O*-galloyl)-α-L-rhamnopyranoside (**230**)	192
Myrsinaceae	*Maesa*	*lanceolata* (leaves)	Quercetin-3-O-3''',6'''-diacetylglucopyranosyl (1→4)-2'',3''-diacetylrhamnopyranoside(**204**)	193
	Maesa	*lanceolata* (leaves)	Quercetin-3-*O*-β-galactopyranosyl (1→4)-rhamnopyranoside-7-*O*-β-galactopyranoside (**206**)	193
	Maesa	*lanceolata* (leaves)	Myricetin-3-*O*-2'',3'',4''-triacetyloxypyranoside (**227**)	193
	Maesa	*lanceolata* (leaves)	Myricetin-3-*O*-xylopyranosyl(1→3)-α-rhamnopyranoside (**228**)	193
Nyctaginaceae	*Pisonia*	*morindiflore*	4''-*O*-Methyl-5'-acetyl myricetin -3-*O*-glucosyl (2→1)rhamnoside (**232**)	194
Orchidaceae	*Sasa*	*borealis*	Luteolin-6-*C*-α-L-arabinopyranoside (**113**)	195
		borealis	Tricin-7-*O*-β-D-glucopyranoside (**125**)	195
Pinaceae	*Pinus*	*densiflora* (needles)	5,7,8,4'-Tetrahydroxy-3-methoxy-6-methylflavone-8-*O*-β-D-glucopyranoside(**71**)	197
	Juniperus	*zeravchanica*	5,6,8,3',4'-Pentahydroxy-7-*O*-β-D-gluco-pyranosylflavone [Zeravschanoside] (**75**)	198
Piperaceae	*Piper*	*ihotzkyanum* (leaves)	5-Hydroxy-7-methoxy 8-*C*-β−glucosylflavone [Kaplanin](**79**)	199
	Limonium	*sinense* (aerial parts)	Myricetin-3-*O*-(2''-*O*-*p*-hydroxybenzoyl)-α- rhamnopyranoside (**231**)	200
Poaceae	*Hyparrhenia*	*hirta* (leaves)	Tricin-4'-*O*-(erythro-β-guaiacylglycerol) ether (**124**)	201
Polygonaceae	*Oxyria*	*digyna* (whole plant)	5,7,2',3',4'-Pentahydroxyflavone-8-*C*-gluco-pyranoside (**86**)	202
Primulaceae	*Lysimachia*	*capillipes*	Capilliposide 1	140
	Lysimachia	*capillipes*	Capilliposide 2	140
	Primula	*veris* (flowers)	3',4',5'-Trimethoxy flavone (**10**)	196
Punicaceae	*Punica*	*granatum* (bark)	Quercetin-3,4'-dimethylether-7-*O*-α-L-arabinofuranosyl(1→6)-β-D-glucopyranoside (**208**)	203
Rutaceae	*Murraya*	*paniculata* (stem bark)	3,5,6,7,3',4',5'-Heptamethoxy flavone (**39**)	59
	Murraya	*paniculata* (stem bark)	3,5,6,7,8,3',4',5'-Octamethoxy flavone (**40**)	59

(Table 2) contd…..

Family	Genus	Species	Flavones and Flavonols	Ref.
	Murraya	*paniculata* (stem bark)	3,5,7,3',4',5'-Hexamethoxy flavone (**41**)	59
	Melicope	*micrococca* (aerial parts)	3,5,4'-Trihydroxy-8,3'-dimethoxy-7-(3-methylbut-2-enoxy)flavone (**137**)	204
	Melicope	*micrococca* (aerial parts)	3,5,8,4'-Tetrahydroxy-7,3'-dimethoxy-6-(3-methylbut-2-enyl)flavone (**138**)	204
Rosaceae	*Cotoneaster*	*orbicularis* (whole plant)	6,8-Di-*C*-β-cellobiosyl apigenin (**117**)	205
	Prunus	*spinosa* (leaves)	Kaempferol-3-*O*-(2''-*O*-*E*-*p*-coumaroyl)-α-L-arabinofuranoside-7-*O*-α-L-rhamnopyrano side (**177**)	206
	Prunus	*spinosa* (leaves)	Quercetin-3-*O*-(2''-*O*-β-D-glucopyranosyl)-α-L-arabino furanoside (**205**)	206
	Prunus	*mume* (fresh flowers)	2''-*O*-acetyl rutin (**235**)	207
	Prunus	*mume* (fresh flowers)	2''-*O*-acetyl-3'-*O*-methylrutin (**236**)	207
	Alchemilla	*speciose* (leaves)	Kaempferol-3-*O*-β-(2''-*O*-α-L-rhamnopyranosyl) glucopyrano side uronic acid (**162**)	208
	Alchemilla	*speciose* (leaves)	Quercetin-3-*O*-β-(2''-*O*-α-L-rhamnopyranosyl) glucopyranoside uronic acid (**193**)	208
	Alchemilla	*xanthochlora*	Quercetin-3-*O*- α -L-arabinopyranoside (**184**)	209
	Alchemilla	*xanthochlora*	Quercetin-3-*O*-α-L-arabinopyranoside (**203**)	209
	Colegyne	*ramosissima* (aerial parts)	Isorhamnetin-3-*O*-2^{G}-rhamnopyranosyl rutinoside-7-*O*-α-rhamnopyranoside (**218**)	210
	Colegyne	*ramosissima* (aerial parts)	Limocitrin-3-*O*-rutinoside-7-*O*- β -glucopyranoside (**234**)	210
Ranuculaceae	*Aconitum*	*napellus* (flowers)	Kaempferol-3-*O*-(6-*trans*-caffeoyl)-β-glucopyranosyl (1→2)-β-glucopyranoside-7-*O*-α -rhamnopyranoside (**157**)	211
	Aconitum	*napellus* (flowers)	Kaempferol-3-*O*-(6-*trans*-*p*-coumaroyl)-β-glucopyranoside-7-*O*-α-rhamnopyranoside (**158**)	211
	Aconitum	*napellus* (flowers)	Quercetin-3-*O*-(6-*trans*-caffeoyl) -β-glucopyranosyl(1→2)-β-glucopyranoside-7-*O*-α -rhamnopyranoside (**200**)	211
	Aconitum	*napellus* (flowers)	Quercetin-3-*O*-(6-*trans*-caffeoyl) -β-glucopyranosyl(1→3)-α-rhamnopyranoside-3-*O*-β -glucopyranoside (**182**)	212
	Thalictrum	*atriplex* (aerial parts)	Kaempferol-3-*O*-{3''-acetyl-α-L-arabinopyranosyl(1''→6''')}-β -D-glucopyranoside (**169**)	213
Resedaceae	*Raseda*	*muricata* (leaves)	Kaempferol-3-*O*-β-D-glucopyranosyl(1'''→2'')-*O*-α-L-rhamnopyranoside-7-*O*-β-D-gluco-pyranoside (**173**)	214
	Raseda	*muricata* (leaves)	Kaempferol-3-*O*-β-D-glucopyranosyl(1'''→2'')-*O*-α-L-rhamnopyranoside-7-*O*-β-D-(6''''-*O*-*E*-coumaroyl) glucopyranoside (**174**)	214
Rubiaceae	*Hedyotis*	*diffusa*	Kaempferol-3-*O*-{2''-*O*-(*E*-6'''-*O*-feruloyl)-β-D-glucopyranosyl}-β-D-galactopyranoside (**163**)	40
	Adina	*cordofolia* (heart wood)	3,4',5,7-Tetraacetylquercetin (**210**)	215
	Putoria	*calabrica* (aerial parts)	Quercetin-3-*O*-{α-L-rhamnopyranosyl (1→2)-α-L-arabinopyranoside}-7-*O*-β−D-glucopyra-noside [Calabricoside A] (**187**)	17
	Putoria	*calabrica* (aerial parts)	Quercetin-3-*O*-{4'''-*O*-caffeoyl- α-L- rhamnopyranosyl (1→2)- α-L-arabinopyrano-side}-7-*O*- β-D-glucopyranoside[Calabricoside B] (**188**)	17
Scrophulariaceae	*Limnophila*	*rugosa* (whole plant)	5,7-Dihydroxy, 8,3',5'-trimethoxyflavone (**46**)	216

(Table 2) contd…..

Family	Genus	Species	Flavones and Flavonols	Ref.
	Limnophila	*indica* (whole plant)	5,8-Dihydroxy, 6,7,4'-trimethoxyflavone (**47**)	217
	Limnophila	*indica* (whole plant)	5,2'-Dihydroxy-8,3',4'-trimethoxyflavone (**48**)	218
	Limnophila	*indica* (whole plant)	3',4'-Ethylenedioxy-5-hydroxy-3-(1-hydroxy-1-methylethyl)-6,7-dimethyl-5'-methoxy- flavone-8-carboxylic acid (**50**)	219
	Paullinia	*pinnata* (leaves)	Diosmetin-7-*O*-(2''-*O*-β-D-apiofuranosyl-6''-acetyl)-β-D–glucopyranoside (**91**)	220
	Paullinia	*pinnata* (leaves)	Tricetin-4'-*O*-methyl-7-*O*-(2''-*O*-β-D-apiofuranosyl-6''-acetyl)-β-D-glucopyranoside (**126**)	220
	Picria	*felterrae*	Apigenin-7-*O*-β-(2''-*O*-α-rhamnosyl)-glucuronide (**119**)	221
Sapindaceae	*Dodonea*	*angustofolia* (leaves)	5,7,4'-Trihydroxy-3,6-dimethoxy flavone (**5**)	222
Sterculiaceae	*Helicteres*	*isora* (fruits)	Isoscutellarein-4'-methylether-8-*O*-β-D-glucuronide-6''-*n*-butyl ester (**93**)	223
	Helicteres	*isora* (fruits)	Isoscutellarein-4'-methyl ether-8-*O*−β-D-glucuronide-2'',4''-disulphate (**94**)	223
	Helicteres	*isora* (fruits)	Isoscutellarein-8-*O*-β-D-glucuronide-2'',4''-disulphate (**95**)	223
	Helicteres	*isora* (fruits)	Isoscutellarein-4'-methyl ether-8-*O*−β-D-glucuronide (**96**)	223
	Helicteres	*isora* (fruits)	Isoscutellarein-4'-methyl ether-8-*O*−β-D-glucuronide-2''-sulphate (**97**)	223
Urticaceae	*Urtica*	*dioica* (roots)	5,2',4'-Trihydroxy-7,8-dimethoxyflavone (**6**)	224
Umbelliferae	*Angelica*	gigas (roots)	Diosmetin-7-*O*-α-L-rhamnopyranosyl (1→6)-β-D-glucopyranoside (**92**)	225
Valerianaceae	*Valeriana*	*jatamansi* (rhizomes and roots)	Acacetin-7-*O*-β-sophoroside (**128**)	226
	Valeriana	*jatamansi* (rhizomes and roots)	Acacetin-7-*O*-(6''-*O*-α-L-rhamnopyranosyl)-β-sophoroside (**129**)	226
Avicenniaceae (Verbenaceae)	*Lantana*	*camara*	5,7-Dihydroxy-4',6-dimethoxy flavone (**2**)	227
	Duranta	*repens*	5,7-Dihydroxy-3'-(2-hydroxy-3-methyl-3-butenyl)-3,6,4'-trimethoxyflavone(**21**)	52
	Duranta	*repens*	5-hydroxy-3,6,7,4'-tetramethoxyflavone (**23**)	52
	Duranta	*repens*	3,7-Dihydroxy-3'-(2-hydroxy-3-methyl-3-butenyl)-5,6,4'-trimethoxyflavone(**131**)	52
	Avicennia	*marina* (aerial parts)	Chrysoeriol-7-*O*-glucoside (**74**)	228
	Avicennia	***marina*** (aerial parts)	Luteolin-7-*O*-methylether-3'-*O*-β-D-galactoside (**111**)	228
	Avicennia	*marina* (aerial parts)	Luteolin-7-*O*-methylether-3'-*O*-β-D-glucoside (**112**)	228
Zingiberaceae	*Ammomium*	*koenigii* (fruits)	3,5,3'-Trihydroxy-7,4'-dimethoxyflavone (**139**)	229
	Costus	*spicatus* (leaves)	Kaempferide-3-*O*-neohesperido side (**159**)	75
	Costus	*spicatus* (leaves)	Tamarixetin-3-*O*-neohesperidoside (**233**)	75
	Costus	*spiralis*	3,5-Dihydroxy-7,4'-dimethoxyflavone-3-*O*-neohesperidoside (**241**)	230
	Alpinia	*flabellate* (leaves)	*Rel*-5-hydroxy-7,4'-dimethoxy-2''-*S*-(2,4,5-trimethoxy-*E*-styryl)-tetrahydrofuro-{4''-*R*,5''-*R*; 2,3} flavonol	231



1 $R_1=R_5=R_6=R_8=R_9=H$; $R_2=R_{10}=OH$; $R_3=R_4=R_7=OMe$
2 $R_1=R_5=R_6=R_7=R_9=R_{10}=H$; $R_2=R_4=OH$; $R_3=R_8=OMe$
3 $R_1=R_4=R_7=R_9=OMe$; $R_2=R_3=R_5=R_6=R_{10}=H$; $R_8=OH$
4 $R_1=R_4=R_7=OMe$; $R_2=R_3=R_5=R_6=R_{10}=H$; $R_8=R_9=OH$
5 $R_1=R_3=OMe$;$R_5=R_6=R_7=R_9=R_{10}=H$; $R_2=R_4=R_8=OH$
6 $R_1=R_3=R_7=R_9=R_{10}=H$; $R_2=R_6=R_8=OH$; $R_4=R_5=OMe$
7 $R_1=R_3=R_5=R_6=R_7=R_9=R_{10}=H$; $R_2=R_4=R_8=OH$
8 $R_1=R_3=R_4=R_5=R_6=R_9=R_{10}=H$; $R_2=R_7=R_8=OH$
9 $R_1=R_5=R_6=R_9=R_{10}=H$; $R_2=R_7=OH$; $R_3=R_4=R_8=OMe$
10 $R_1=R_2=R_3=R_4=R_5=R_6=R_{10}=H$; $R_7=R_8=R_9=OMe$
11 $R_1=R_6=R_{10}=H$; $R_2=OH$; $R_3=R_5=Me$; $R_4=R_9=OMe$; $R_7=R_8=-O-CH_2-O-$
12 $R_1=R_3=R_6=R_{10}=H$; $R_2=OH$; $R_4=OMe$; $R_5=Me$; $R_7=R_8=-O-CH_2-O-$; $R_9=-CH_2CH=CMe_2$
13 $R_1=R_7=R_8=R_9=OMe$; $R_2=OAc$; $R_3=R_4=R_5=R_6=R_8=R_{10}=H$
14 $R_1=R_3=R_4=R_8=R_9=OMe$; $R_2=R_7=OH$; $R_5=R_6=R_{10}=H$
15 $R_1=R_3=R_4=R_7=R_9=OMe$; $R_2=R_8=OH$; $R_5=R_6=R_{10}=H$
16 $R_1=R_3=R_4=R_7=R_8=R_9=OMe$; $R_2=OH$; $R_5=R_6=R_{10}=H$
17 $R_1=R_3=R_5=R_6=R_{10}=H$; $R_2=R_4=R_7=R_8=R_9=OMe$
18 $R_1=R_3=R_5=R_7=R_8=R_9=R_{10}=H$; $R_2=R_4= R_6=OMe$
19 $R_1=R_3=R_5=R_7=R_9=H$; $R_2=R_4=R_6=R_8=R_{10}=OMe$
20 $R_1=R_2=R_3=R_5=R_7=R_9=R_{10}=H$; $R_4=R_6=R_8=OMe$
21 $R_1=R_3=R_8=OMe$; $R_2=R_4=OH$; $R_5=R_6=R_9=R_{10}=H$; $R_7=CH_2CH(OH)C(Me)=CH_2$
22 $R_1=R_6=R_7=R_9=R_{10}=H$; $R_2=R_8=OH$; $R_3=R_4=R_5=OMe$
23 $R_1=R_3=R_4=R_8=OMe$; $R_2=OH$; $R_5=R_6=R_7=R_9=R_{10}=H$
24 $R_1=R_5=R_8=OMe$; $R_2=R_4=OH$; $R_3=Me$; $R_6=R_7=R_9=R_{10}=H$
25 $R_1=R_8=R_9=H$; $R_2=R_4=R_7=R_{10}=OH$; $R_3=R_5=R_6=OMe$
26 $R_1=R_3=R_5=R_7=R_8=R_9=R_{10}=H$; $R_2=OMe$; $R_4=R_6=OH$
27 $R_1=R_3=R_5=R_{10}=H$; $R_2=R_4=OH$; $R_6=R_7=R_8=R_9=OMe$
28 $R_1=R_3=R_5=R_{10}=H$; $R_2=R_8=OH$; $R_4=R_6=R_7=R_9=OMe$
29 $R_1=R_3=R_5=R_{10}=H$; $R_2=R_4=R_8=OH$; $R_6=R_7=R_9=OMe$
30 $R_1=R_3=R_7=R_8=R_9=H$; $R_2=R_4=R_6=R_{10}=OH$; $R_5=OMe$
31 $R_1=R_6=R_7=R_9=R_{10}=H$; $R_2=R_4=R_5=OH$; $R_3=R_8=OMe$
32 $R_1=R_3=R_4=R_5=R_8=OMe$; $R_2=OH$; $R_6=R_7=R_9=R_{10}=H$
33 $R_1=R_3=R_4=R_5=OMe$; $R_2=OH$; $R_6=R_7=R_8=R_9=R_{10}=H$
34 $R_1=R_4=OMe$; $R_2=R_3=OH$; $R_5=R_6=R_7=R_8=R_9=R_{10}=H$
35 $R_1=R_3=OMe$; $R_2=R_4=R_6=OH$; $R_5=R_7=R_8=R_9=R_{10}=H$
36 $R_1=R_3=R_4=OMe$; $R_2=R_6=OH$; $R_5=R_7=R_8=R_9=R_{10}=H$
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38 $R_1=R_5=R_6=R_9=R_{10}=H$; $R_2=R_8=OH$; $R_3=R_4=R_7=OMe$
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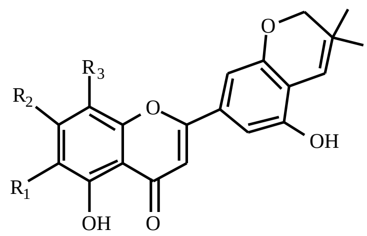
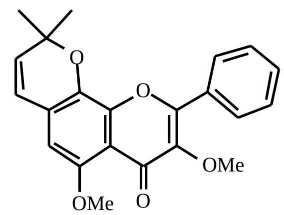
40 $R_1=R_2=R_3=R_4=R_5=R_7=R_8=R_9=OMe$; $R_6=R_{10}=H$
41 $R_1=R_2=R_4=R_7=R_8=R_9=OMe$; $R_3=R_5=R_6=R_{10}=H$
42 $R_1=R_5=R_9=R_{10}=H$; $R_2=R_4=R_8=OH$; $R_3=R_6=R_7=OMe$
43 $R_1=R_5=R_6=R_7=R_9=R_{10}=H$; $R_2=R_4=R_8=OH$; $R_3=CH_2CH(OH)C(Me)=CH_2$
44 $R_1=R_5=R_6=R_9=R_{10}=H$; $R_2=R_3=R_4=OMe$; $R_7=R_8=-O-CH_2-O-$
45 $R_1=R_5=R_6=R_{10}=H$; $R_2=R_3=R_4=R_9=OMe$; $R_7=R_8=-O-CH_2-O-$
46 $R_1=R_3=R_6=R_8=R_{10}=H$; $R_2=R_4=OH$; $R_5=R_7=R_9=OMe$
47 $R_1=R_6=R_7=R_9=R_{10}=H$; $R_2=R_5=OH$; $R_3=R_4=R_8=OMe$
48 $R_1=R_3=R_4=R_9=R_{10}=H$; $R_2=R_6=OH$; $R_5=R_7=R_8=OMe$
49 $R_1=R_3=R_5=R_6=R_9=R_{10}=H$; $R_2=R_4=OMe$; $R_7=R_8=-O-CH_2-O-$
50 $R_1=C(OH)Me_2$; $R_2=OH$; $R_3=R_4=OMe$; $R_5=COOH$; $R_6=R_{10}=H$; $R_7=R_8=-O-CH_2-CH_2-O-$; $R_9=OMe$
51 $R_1=R_2=R_3=R_6=R_9=R_{10}=H$; $R_4=R_5=OMe$; $R_7=R_8=-O-CH_2-O-$
52 $R_1=R_2=R_3=R_4=R_5=R_9=OMe$; $R_6=R_{10}=H$; $R_7=R_8=-O-CH_2-O-$
53 $R_1=R_5=R_6=R_{10}=H$; $R_2=R_4=R_9=OMe$; $R_3=-CH=CHC(OH)Me_2$ (*E*); $R_7=R_8=-O-CH_2-O-$
54 $R_1=R_2=R_3=R_5=OMe$; $R_4=OH$; $R_6=R_9=R_{10}=H$; $R_7=R_8=-O-CH_2-O-$
55 $R_1=R_2=R_3=R_5=OMe$; $R_4=O-C(Me)=CMe_2$; $R_6=R_9=R_{10}=H$; $R_7=R_8=-O-CH_2-O-$

Fig. (1). Contd…..



56 $R_1=R_2=$-O-CH_2-O-; R_3=Me
57 $R_1=R_3$=Me; R_2=OAc
58 $R_1=R_3$=Me; R_2=OCH(Me)$CH_2CH_2CH_3$



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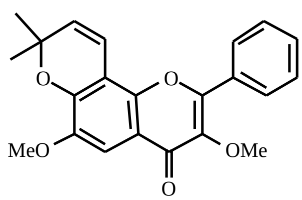

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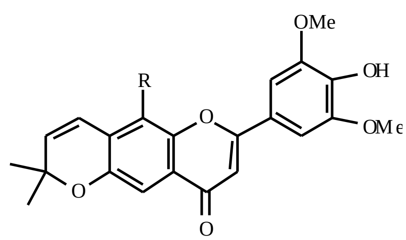
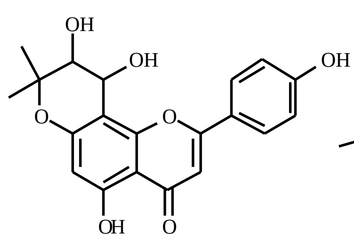


61 R=H
62 R=OMe



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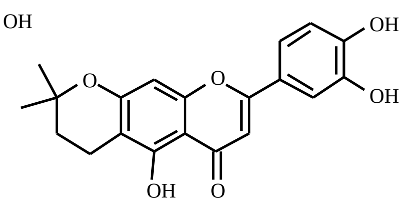

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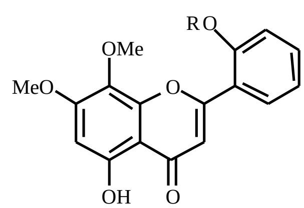
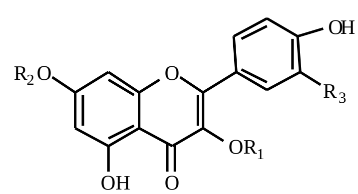
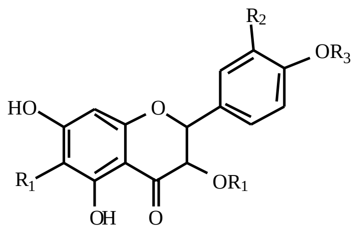


65
R=β-D-(4''-*E*-cinnamyl) glucopyranosyl

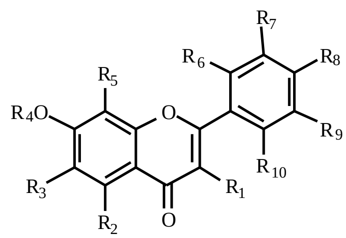


66 R_1=β-D-glucopyranosyl; R_2=H; R_1=OSO_3Na
67 R_1=Me; R_2=β-D-glucopyranouronyl; R_3=H

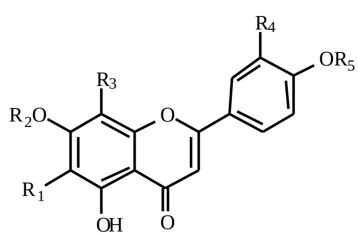
Fig. (1). Contd…..



68 R_1=deoxyribosehexos-3-ulosyl; R_2=R_3=H
69 R_1=deoxyribosehexos-3-ulosyl; R_2=OH; R_3=H
70 R_1=deoxyribosehexos-3-ulosyl; R_2=OH; R_3=Me

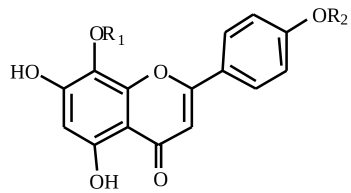


71 R_1=OMe; R_2=R_8=OH; R_3=Me; R_4=R_6=R_7=R_9=R_{10}=H; R_5=*O*-β-D-glucopyranosyl
72 R_1=R_3=R_5=R_6=R_{10}=H; R_2=*O*-β-D-xylopyranosyl (1→2)-α-L-rhamnopyranosyl; R_4=Me; R_7=R_8=R_9=OMe
73 R_1=R_3=OMe; R_2=R_6=R_7=R_8=OH; R_4=β-D-glucopyranosyl; R_5=R_9=R_{10}=H
74 R_1=R_3=R_5=R_6=R_9=R_{10}=H; R_2=R_8=OH; R_4=glucosyl; R_7=OMe
75 R_1=R_6=R_9=R_{10}=H; R_2=R_3=R_5=R_7=R_8=OH; R_4=β-D-glucopyranosyl
76 R_1=R_3=R_6=R_7=R_8=R_9=R_{10}=H; R_2=R_5=OMe; R_4=β-D-glucopyranosyl
77 R_1=R_5=R_6=R_9=R_{10}=H; R_2=R_7=R_8=OH; R_3=OMe; R_4=α-L-rhamnopyranosyl (1→2)-*O*-β-D-galactopyranosyl
78 R_1=OMe; R_2=R_7=R_8=OH; R_3=R_5=R_6=R_9=R_{10}=H; R_4=β-D-galactopyranosyl(1→4)-*O*-β−D-glucopyranosyl
79 R_1=R_3=R_6=R_7=R_8=R_9=R_{10}=H; R_2=OH; R_4=Me; R_5=β−glucosyl
80 R_1=R_5=R_6=R_7=R_9=R_{10}=H; R_2=OH; R_3=R_8=OMe; R_4=glycosyl
81 R_1=R_3=OMe; R_2=*O*-β-D-xylopyranosyl(1→4)-*O*-β-D- glucopyranosyl; R_4=Me; R_5=R_7=R_8=R_9=R_{10}=H; R_6=OH
82 R_1=R_3=R_8=OMe; R_2=OH; R_4=α-L-arabinopyranosyl(1→4)-*O*-α-L-rhamnopyranosyl (1→3)-*O*-β-D-xylopyranosyl; R_5=R_6=R_7=R_9=R_{10}=H
83 R_1=R_5=R_6=R_7=R_8=R_9=R_{10}=H; R_2=OH; R_3=*O*-β-D-xylopyranosyl; R_4=Me
84 R_1=R_3=R_4=R_6=R_8=R_9=R_{10}=H; R_2=R_8=OH; R_5=β-D-xylopyranosyl-2''-*O*-glucosyl; R_7=OMe
85 R_1=R_3=R_4=R_6=R_9=R_{10}=H; R_2=OH; R_5=β-D-xylopyranoside-2''-*O*-glucosyl; R_7=OMe; R_8=OAc;
86 R_1=R_3=R_4=R_9=R_{10}=H; R_2=R_6=R_7=R_8=OH; R_5= glucopyranosyl
87 R_1=R_3=R_5=R_6=R_9=R_{10}=H; R_2=R_7=OH; R_8=*O*-angeloxyl; R_4=β-D-glucopyranosyl;
88 R_1=R_4=R_5=R_6=R_7=R_9=R_{10}=H; R_2=R_8=OH; R_3=*trans*-2''-*O*-(α-rhamnopyranosyl)-ethenyl;
89 R_1=R_3=R_4=R_5=R_6=R_7=R_9=R_{10}=H; R_2=*O*-α-L-rhamnopyranosyl(1→6)-*O*-β-D-galactopyranosyl; R_8=OMe

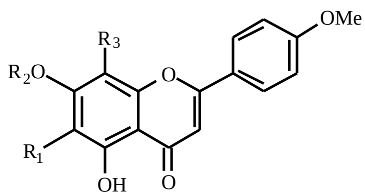


90 R_1=2''-*O*-rhamnosylglucosyl; R_2=OMe; R_3=R_4=H; R_5=glycosyl
91 R_1=R_3=H; R_2=(2''-*O*-β-D-apiofuranosyl-6''-acetyl)-β-D–glucopyranosyl; R_4=OH; R_5=Me
92 R_1=R_3=H; R_2=α-L-rhamnopyranosyl (1→6)-β-D-glucopyranosyl; R_4=OH; R_5=Me

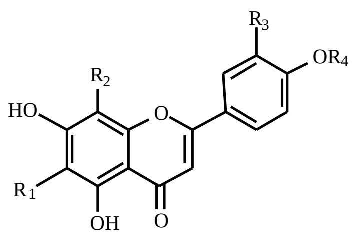
Fig. (1). Contd…..



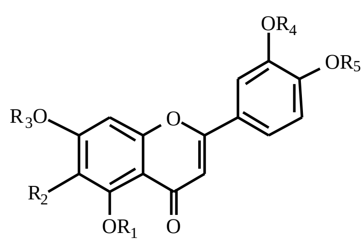
93 R_1=β-D-glucuronyl-6"-*n*-butyl ester; R_2=Me
94 R_1=β-D-glucuronyl-2",4"-disulphate; R_2=Me
95 R_1=β-D-glucuronyl-2",4"-disulphate; R_2=H
96 R_1=β-D-glucuronyl; R_2=Me
97 R_1=β-D-glucuronyl-2"-sulphate; R_2=Me



98 R_1=α-L-rhamnopyranosyl(1→3)-β-D-glucopyranosyl; R_2=R_3=H
99 R_1=β-D-apiofuranosyl (1→3)-β-D-glucopyranosyl; R_2=R_3=H
100 R_1=R_2=H; R_3=α-L-rhamnopyranosyl (1→3)-β-D-xylopyranosyl(1→6)}-β-D-glucopyranosyl
101 R_1=β-D-glucopyranosyl; R_2=R_3=H

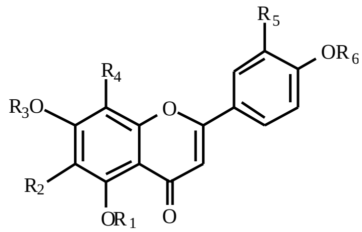


102 R_1=2"-*O*-(6'''-(*E*)-*p*-coumaroyl) glucosyl; R_2=R_4=H; R_3=OMe
103 R_1=2"-*O*-(6'''-(*E*)-*p*-feruloyl) glucosyl; R_2=H; R_3=OMe; R_4=glucosyl
104 R_1=2"-*O*-(6'''-(*E*)-*p*-coumaroyl) glucosyl; R_2=R_3=R_4=H
105 R_1=2"-*O*-(6'''-(*E*)-*p*-coumaroyl) glucosyl; R_2=R_3=H; R_4=glucosyl
106 R_1=2"-*O*-(6'''-(*E*)-*p*-feruloyl) glucosyl; R_2=R_3=H; R_4=glucosyl
107 R_1=2"-*O*-galloylglucosyl; R_2=R_4=H; R_3=OH
108 R_1=2"-*O*-galloylglucosyl; R_2=R_3=R_4=H
109 R_1=R_3=R_4=H; R_2=2"-*O*-galloylglucosyl
110 R_1=R_4=H; R_2=2"-*O*-galloylglucosyl; R_3 = OH

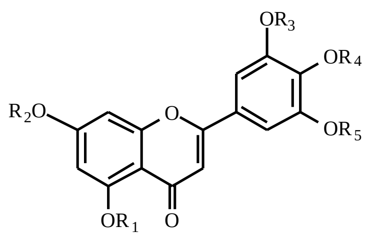


111 R_1=R_2=R_5=H; R_3=Me; R_4=β-D-galactosyl
112 R_1=R_2=R_5=H; R_3=Me; R_4=β-D-glucosyl
113 R_1=R_3=R_4=R_5=H; R_2=α-L-arabinopyranosyl
114 R_1=R_2=R_4=R_5=H; R_3=rutinosyl
115 R_1=R_2=R_3=R_5=H; R_4=β-D-glucoronyl
116 R_1=R_2=R_3=R_4=H; R_5=neohesperidosyl

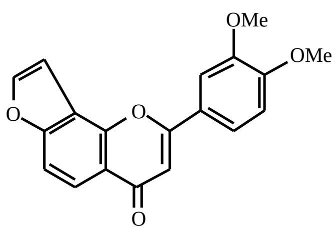
Fig. (1). Contd…..



117 R_1=R_3=R_5=R_6=H; R_2=R_4=β-cellobiosyl
118 R_1=R_2=R_4=R_5=R_6=H; R_3=rutinosyl
119 R_1=R_2=R_4=R_5=R_6=H; R_3=β-(2"-*O*-α-rhamnosyl)-glucuronyl
120 R_1=R_2=R_4=R_5=R_6=H; R_3=3",6"-di-(*E*)-*p*-coumaroyl-β-D-galactopyranosyl
121 R_1=R_2=R_4=R_5=R_6=H; R_3=6"-(*E*)-*p*-coumaroyl-β-D-galactopyranosyl
122 R_1=R_2=R_3=R_5=H; R_4=2"-glucosyl glucosyl; R_6=Me
123 R_1=R_2=R_4=R_6=H; R_3=α-L-rhamnopyranosyl (1→6)-*O*-β-D-glucopyranosyl; R_5=prenyl



124 R_1=R_2=H; R_3=R_5=Me; R_4=erythro-β-guaiacylglyceryl
125 R_1=R_4=H; R_2=β-D-glucopyranosyl; R_3=R_5=Me
126 R_1=R_3=R_5=H; R_2=2"-*O*-β-D-apiofuranosyl-6"-acetyl-β-D-glucopyranosyl; R_4=Me



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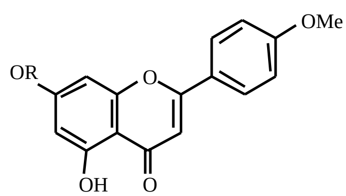
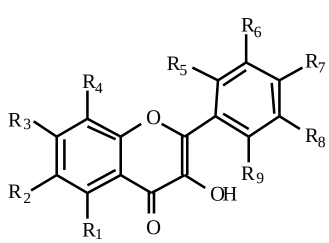


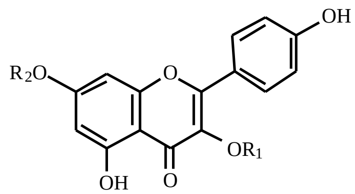
128 R=β-sophorosyl
129 R=6"-*O*-α-L-rhamnopyranosyl-β-sophorosyl

Fig. (1). Structures of newly isolated flavones**.**

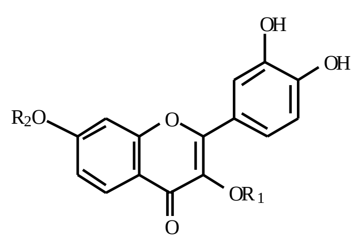


130 R_1=R_6=OH; R_2=R_4 =R_7=R_8=R_9=H; R_3=R_5=OMe
131 R_1=R_2=R_7 =OMe; R_3=OH; R_4=R_5=R_8=R_9=H; R_6=$CH_2CH(OH)C(Me)=CH_2$
132 R_1=R_2=R_4=R_5=R_9=H; R_3=R_6=R_8=OMe; R_7=OH
133 R_1=OH; R_2=R_3=R_6=OMe; R_4=R_5=R_7=R_8=R_9=H
134 R_1=R_2=R_4=R_5=R_6=R_8=R_9=H; R_3=R_7=OH
135 R_1=R_6=OH; R_7=OMe; R_2=R_3=-O-CH_2-O-; R_4=R_5=R_8=R_9=H
136 R_1=R_2=R_4=R_5=R_9=H; R_3=R_7=OH; R_6=R_8=OMe
137 R_1=R_7=OH; R_2=R_5=R_8=R_9=H; R_3=O-CH_2-CH=$CHMe_2$; R_4=R_6=OMe
138 R_1=R_4=R_7=OH; R_2=CH_2-CH=$CHMe_2$; R_3=R_6=OMe; R_5=R_8=R_9=H
139 R_1=R_6=OH; R_2=R_4=R_5=R_8=R_9=H; R_3=R_7=OMe

Fig. (2). Contd…..



140 R_1=β-D-glucopyranosyl; R_2=H
141 R_1=β-(6"-*O*-*E*-*p*-coumaroyl glucosyl); R_2=β-glucosyl
142 R_1=β-D-apiofuranosyl; R_2=α-L-rhamnosyl (1""→6"')-*O*-β-D-galactopyranosyl
143 R_1=β-D-apiofuranosyl; R_2=α-L-rhamnosyl (1""→6"')-*O*-β-D-(2"'-*O*-*E*-caffeoyl) galactopyranosyl
144 R_1={β-D-xylopyranosyl (1→3)-α-L-rhamnopyranosyl (1→6)-α-L-rhamnopyranosyl (1→2)}-β-D-galactopyranosyl; R_2=H
145 R_1=α-L-rhamnopyranosyl (1→2)-β-D-glucopyranosyl (1→6)-β-D-galactopyranosyl; R_2=H
146 R_1=α-L-6"-*p*-coumaroyl-β-D-glucopyranosyl (1→2)-rhamnopyranosyl; R_2=β-D-glucopyranosyl
147 R_1=glucosyl(1→2)-rhamnosyl; R_2=glucosyl
148 R_1=(6"-*p*-coumaroylglucosyl) (1→2)-rhamnosyl; R_2=glucosyl
149 R_1=(4"-*p*-coumaroylglucosyl)(1→2)-rhamnosyl; R_2=glucosyl
150 R_1=β-D-glucosyl(1→2)-β-D-galactosyl; R_2=β-D-glucosyl
151 R_1=β-D-glucosyl(1→2)-(6"-*O*-acetyl)-β-D-galactosyl; R_2=β-D-glucosyl
152 R_1=α-L-rhamnopyranosyl(1→6)-*O*-{α-L-arabinopyranosyl(1→3)-*O*-α-L-rhamnopyranosyl(1→2)-*O*-β-D-galactopyranosyl; R_2=H
153 R_1=(3"-*O*-α-L-rhamnopyranosyl)-α-L-rhamnopyranosyl; R_2=H
154 R_1=β-{β-D-glucopyranosyl(1→6)-D-glucopyranosyl}; R_2=α-L-rhamnopyranosyl
155 R_1=β-D-glucopyranosyl; R_2=α-L-rhamnopyranosyl
156 R_1=α-L-rhamnopyranosyl; R_2=α-L-rhamnopyranosyl
157 R_1=(6-*trans*-caffeoyl)-β-glucopyranosyl(1→2)-β-glucopyranosyl; R_2=α-rhamno-pyranosyl
158 R_1=(6-*trans*-*p*-coumaroyl)-β-glucopyranosyl; R_2=α-rhamnopyranosyl
159 R_1=neohesperidosyl; R_2=H
160 R_1={2"-(6"'-*p*-coumaroyl-β-D-glucopyranosyl)-α-L-arabinopyranosyl}; R_2=β-D-glucopyranosyl
161 R_1=α-L-rhamnopyranosyl(1→6){α-L-rhamnopyranosyl(1→2)}-β-D-galactopyranosyl; R_2=α-L-rhamnopyranosyl
162 R_1=β-(2"-*O*-α-L-rhamnopyranosyl)glucopyranosyl uronic acid; R_2=H
163 R_1={2"-*O*-(*E*-6"'-*O*-feruloyl)-β-D-glucopyranosyl}-β-D-galactopyranosyl; R_2=H
164 R_1=β-D-glucosyl; R_2=H
165 R_1=β-D-glucosyl(1→2)-α-L-rhamnosyl; R_2=H
166 R_1=β-D-rutinosyl; R_2=H
167 R_1=*Trans*-*p*-coumaroyl; R_2=H
168 R_1=α-rhamnosyl; R_2=H
169 R_1={3"-acetyl-α-L-arabinopyranosyl(1"→6"')}-β-D-glucopyranosyl; R_2=H
170 R_1={2"-*O*-(*trans*-*p*-coumaroyl)-6"-*O*-acetyl}-β-D-glucopyranosyl; R_2=H
171 R_1={2",6"-di-*O*-(*trans*-*p*-coumaroyl)-3',4"'-di-*O*-acetyl}-β-D-glucopyranosyl; R_2=H
172 R_1={6"-*O*-(*trans*-*p*-coumaroyl)}-β-D-glucopyranosyl; R_2=H
173 R_1=β-D-glucopyranosyl(1"'→2")-*O*-α-L-rhamnopyranosyl; R_2=β-D-glucopyranosyl
174 R_1=β-D-glucopyranosyl(1"'→2")-*O*-α-L-rhamnopyranosyl; R_2=β-D-(6""-*O*-*E*-coumaroyl) glucopyranosyl
175 R_1=(4-β-D-apiofuranosyl)-α-L-rhamnopyranoside; R_2=α-L-rhamnopyranosyl
176 R_1=(4-β-D-xylopyranosyl)-α-L-rhamnopyranosyl; R_2=α-L-rhamnopyranosyl
177 R_1=(2"-*O*-*E*-*p*-coumaroyl)-α-L-arabinofuranosyl; R_2=α-L-rhamnopyranosyl

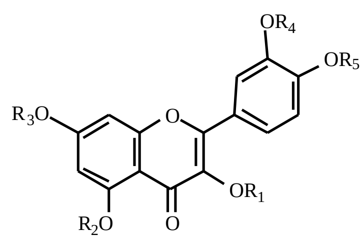


178 R_1=β-(6"-*O*-*E*-*p*-coumaroyl glucosyl; R_2=β-glucosyl
179 R_1=(2",4"-di-*E*-*p*-coumaroyl)-α-L-rhamnopyranosyl; R_2=H
180 R_1=(3",4"-di-*E*-*p*-coumaroyl)-α-L-rhamnopyranosyl; R_2=H
181 R_1=β-D-glucosyl(1→2)-β-D-galactosyl; R_2=β-D-glucosyl
182 R_1=β-glucopyranosyl; R_2=(6-*trans*-caffeoyl)-β-glucopyranosyl (1→3)-α-rhamnopyranosyl

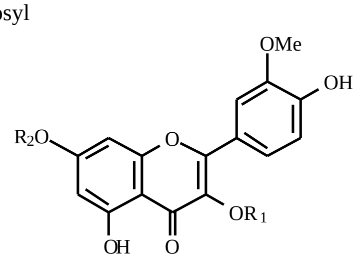
Fig. (2). Contd…..

183 R_1={2''''-*O*-(*E*)-caffeoyl}-α-L-arabinosyl(1→6)-β-D-galactopyranosyl; R_2=H
184 R_1=α-L-arabinopyranosyl; R_2=H
185 R_1=α-L-rhamnopyranosyl(1→2)-β-D-glucopyranosyl(1→6)-β-D-galactopyranosyl; R_2=H

186 R_1=(6-feruloyl-β-glucopyranosyl) (1→2)-β-arabinopyranosyl}; R_2=β-glucopyranosyl
187 R_1={α-L-rhamnopyranosyl (1→2)-α-L-arabinopyranosyl}; R_2=β−D-glucopyranosyl
188 R_1={4'''-*O*-caffeoyl-α-L-rhamnopyranosyl (1→2)-α-L-arabinopyranosyl}; R_2=β-D-glucopyranosyl
189 R_1=galactosyl(6'→1'')-rhamnosyl; R_2=H
190 R_1=galactosyl; R_2=H
191 R_1=glucosyl; R_2=H
192 R_1={2''-(6'''-*p*-coumaroyl-β-D-glucopyranosyl)-α-L-arabinopyranosyl}; R_2=β-D-glucopyranosyl
193 R_1=β-(2''-*O*-α-L-rhamnopyranosyl) glucopyranosyl uronic acid; R_2=H
194 R_1=rutinosyl; R_2=H
195 R_1=β-D-glucosyl; R_2=H
196 R_1=β-D-glucosyl(1→2)-α-L-rhamnosyl; R_2=H
197 R_1=α-L-(3-feruloylrhamnopyranosyl)(1→6){α-L-rhamnopyranosyl(1→2)}-β-D-galactopyranosyl; R_2=H
198 R_1=α-L-(2-feruloylrhamnopyranosyl)(1→6){α-L-rhamnopyranosyl(1→2)}-β-D-galactopyranosyl; R_2=H
199 R_1=(6''-affeoyl)-β-D-galactopyranosyl; R_2=H
200 R_1=(6-*trans*-caffeoyl)-β-glucopyranosyl(1→2)-β-glucopyranosyl; R_2=α−rhamno-pyranosyl
201 R_1=α-L-rhamnopyranosyl(1→2)-α-L-rhamnopyranosyl; R_2=H
202 R_1={6''-α-L-rhamnosyl-6''-β-D-glucosyl}-β-D-glucosyl; R_2=H
203 R_1=α-L-arabinopyranosyl; R_2=H
204 R_1=3''',6'''-diacetylglucopyranosyl(1→4)-2'',3''-diacetylrhamnopyranosyl; R_2=H
205 R_1=(2''-*O*-β-D-glucopyranosyl)-α-L-arabinofuranosyl; R_2=H
206 R_1=β-galactopyranosyl(1→4)-rhamnopyranosyl; R_2=β-galactopyranosyl

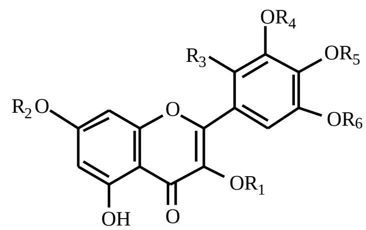


207 R_1=R_3=R_4=R_5=H; R_2=galactosyl
208 R_1=R_5=Me; R_2=R_4=H; R_3=α-L-arabino furanosyl(1→6)-β-D-glucopyranosyl
209 R_1=R_2=R_3=H; R_4=Me; R_5=β-D-glucopyranosyl
210 R_1=R_2=R_3=R_5=$COCH_3$; R_4=H
211 R_1=α-L-(5''-galloyl) arabinofuranosyl; R_2=R_3=R_4=R_5=H
212 R_1=R_3=R_4=R_5=H; R_2=rhamnosyl

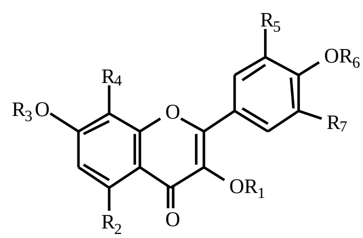


213 R_1=α-L-{6''-*p*-coumaroyl-β-D-glucopyranosyl(1→2)- rhamnopyranosyl; R_2=H
214 R_1=glucosyl; R_2=H
215 R_1=β-6''-*O*-*E*-*p*-coumaroyl glucosyl; R_2=β-glucosyl
216 R_1=β-D-apiofurasyl(1→2)-α-L-rhamnopyranosyl(1→6)-β-D-galactopyranosyl; R_2=H
217 R_1=β-D-xylopyranosyl(1''''→3''')-α-L-rhamnopyranosyl(1'''→6'')-β-D-galactopyranosyl
218 R_1=2^G-rhamnopyranosyl rutinosyl; R_2=α- rhamnopyranosyl
219 R_1=β-D-rutinosyl; R_2=H
220 R_1=β-D-glucosyl(1→2)-α-L-rhamnosyl; R_2=H
221 R_1=R_2=β-D-glucopyranosyl
222 R_1=[2-*O*-β-glucopyranosyl-6-*O*-α-rhamnopyranosyl]-β-glucopyranosyl; R_2=H

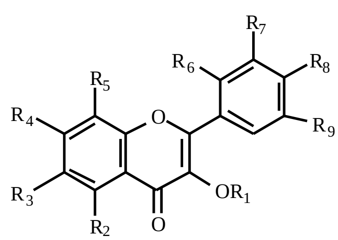
Fig. (2). Contd…..



223 R_1=4"-acetyl-α-L-rhamnpyranosyl; R_2=R_3=R_4=R_5=R_6=H
224 R_1=2"-*O*-galloyl-α-rhamnopyranosyl; R_2=Me; R_3=R_4=R_5=R_6=H
225 R_1=3"-*O*-galloyl-α-rhamnopyranosyl; R_2=Me; R_3=R_4=R_5=R_6=H
226 R_1=2",3"-di-*O*-galloyl-α-rhamnopyranosyl; R_2=R_3=R_4=R_5=R_6=H
227 R_1=2",3",4"-triacetyloxypyranosyl; R_2=R_3=R_4=R_5=R_6=H
228 R_1=xylopyranosyl(1$\rightarrow$3)-α-rhamnopyranosyl; R_2=R_3=R_4=R_5=R_6=H
229 R_1=Me; R_2=R_3=R_4=R_5=R_6=H
230 R_1=4"-*O*-acetyl-2"-*O*-galloyl-α-L-rhamnopyranosyl; R_2=R_3=R_4=R_5=R_6=H
231 R_1=2"-*O*-*p*-hydroxybenzoyl-α-rhamnopyranosyl; R_2=R_3=R_4=R_5=R_6=H
232 R_1=4"-*O*-methylglucosyl(2$\rightarrow$1) rhamnosyl; R_2=R_3=R_4=R_5=H; R_6=COMe



233 R_1=neohesperidosyl; R_2=R_3=R_4=R_6=R_7=H; R_5=OH
234 R_1=rutinosyl; R_2=OH; R_3=β-glucopyranosyl; R_4=R_5=OMe; R_6=R_7=H
235 R_1= 2"-*O*-acetylrutonosyl; R_2=R_3=R_4=R_5=R_6=R_7= H
236 R_1= 2"-*O*-acetylrutonosyl; R_2=R_3=R_4 =R_6=R_7= H; R_5=OMe
237 R_1=β-D-glucopyranosyl(1$\rightarrow$5){β-D-apiofuranosyl(1$\rightarrow$2)}-α-L-arabinofuranosyl; R_2= R_4=R_7=H; R_3=R_6=Me; R_5=OH
238 R_1=R_2=R_3=R_7=H; R_4=*O*-α-D-lyxopyranosyl; R_5=R_6=OH



239 R_1=R_2=R_3=R_6=R_7=R_8=R_9=H; R_4= O-α-L-rhamnopyranosyl (1$\rightarrow$ 4)-α-L-rhamnopyranosyl (1$\rightarrow$6)-β-D-glucopyranosyl; R_5=OMe
240 R_1={α-L-arabinopyranosyl(1$\rightarrow$3)}{β-D-galactopyranosyl(1$\rightarrow$6)-β-D-galactopyranosyl; R_2=R_7=R_8=OH; R_3=R_5=R_6=R_9=H; R_4=OMe
241 R_1=neohesperidosyl; R_2=OH; R_3=R_5=R_6=R_7=R_9=H; R_4=R_8=OMe;
242 R_1=Me; R_2=R_7=R_8=OH; R_3=R_5=R_6=R_9=H; R_4=*O*-α-rhamnopyranosyl(1$\rightarrow$3)-*O*-β-D-galactopyranosyl
243 R_1=β-D-xylopyranosyl(1$\rightarrow$2)-*O*-α-L-rhamnopyranosyl; R_2=R_8=OH; R_3=R_5=R_6=R_9=H; R_4=R_7=OMe
244 R_1=Me; R_2=R_3=R_5=R_6=R_7=R_9=H; R_4=OMe; R_8=*O*-β-{α-rhamnosyl(1$\rightarrow$6)} glucopyranosyl
245 R_1=rutinosyl; R_2=R_3=R_4=R_8=OH; R_5=R_6=R_7=R_9=H
246 R_1=H; R_2=R_7=OMe; R_3=R_5=R_6=R_9=H; R_4=*O*-β-D-glucopyranosyl; R_8=OH
247 R_1=H; R_2=R_7=R_9=OMe; R_3=R_5=R_6=H; R_4=*O*-β-D-glucopyranosyl; R_8=OH
248 R_1=H; R_2=R_7=R_9=OMe; R_3=R_5=R_6=H; R_4=OH; R_8=*O*-β-D-glucopyranosyl
249 R_1=β-D-glucopyranosyl; R_2=R_7=OMe; R_3=R_5=R_6=R_9=H; R_4=R_8=OH

Fig. (2). Structures of newly isolated flavonols.

uminosae, Caesalpiniaceae), Asteraceae (Compositae) and Lamiaceae. The present resumé offers information about 129 flavones and 123 flavonols with new structural patterns.

CONCLUSIONS

The present overview focuses on the natural abundance of recently isolated new flavones and flavonols in the plant kingdom on the one hand and on the other, deals with the pharmacological efficacies along with significant biological activities of these groups of naturally occurring flavonoids. The chemistry of flavones and flavonols has been widely studied and has already been much developed, but in comparison studies conducted so far on the pharmacological/therapeutic applicability and biological activities of such phytochemicals are few. More systematic scientific work is needed. Activities exhibited by these groups of phytochemicals have already created a stir in the scientific community at a large and have attracted present-day workers to undertake systematic studies in more depth, so that the beneficial effects of these important natural components can find safe and effective uses for mankind. We consider this overview should stimulate the progress of research on naturally occurring flavones and flavonols.

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