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Phenolics and flavonoids contents of medicinal plants, as natural ingredients for many therapeutic purposes- A review

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Abstract: The use of dietary or medicinal plant based natural compounds to disease treatment has become a unique trend in clinical research. Polyphenolic compounds, were classified as flavones, flavanones, catechins and anthocyanins. They were possessed wide range of pharmacological and biochemical effects, such as inhibition of aldose reductase, cycloxygenase, Ca+2 -ATPase, xanthine oxidase, phosphodiesterase, lipoxygenase in addition to their antioxidant, antidiabetic, neuroprotective antimicrobial anti-inflammatory, immunomodullatory, gastroprotective, regulatory role on hormones synthesis and releasing…. etc. The current review was design to discuss the medicinal plants contained phenolics and flavonoids, as natural ingredients for many therapeutic purposes.
Keywords: Medicinal plants, phenolics, flavonoids, pharmacology

I. INTRODUCTION:

Phenolic compounds specially flavonoids are widely distributed in almost all plants. Phenolic exerted antioxidant, anticancer, antidiabetes, cardiovascular effect, anti-inflammatory, protective effects in neurodegenerative disorders and many others therapeutic effects . Flavonoids possess a wide range of pharmacological effects including anticancer, antioxidant, antidiabetic, immunological, antiinflammatory, antipyretic, antibacterial, antifungal, antiviral, antiulcer, antiosteoporotic, endocrine, hepatoprotective, vasorelaxant, antiatherosclerotic, antithrombogenic, cardioprotective, anxiolytic and many other effects**.**This review will highlights the phenolic especially flavonoid contents of medicinal plants, their quantitities and types of the phenolic and flavonoid compounds isolated from the medicinal plants[(1-6)].

Plants contained phenolics and flavonoids

Achillea santolina

Achillea santolina contained flavones, particularly flavonoids[(7)]. Ahmad et al isolated two methoxylated flavones from the aerial parts of *Achillea santolina* and identified as 5-hydroxy-3,6,7,3′,4′-pentamethoxyflavone and 7-hydroxy-3,6,3′,4′-tetramethoxyflavone[(8-9)].

Adonis aestivalis

The total phenolics content of the methanolic extract of Adonis aestivalis was 607.26± 2.35 mg GAE/g and total flavonoid content 97.81± 0.007 mg catechin equivalent/g more than their contents in the ethyl acetate extract (378.37±8.64 mg GAE/g, 89.73± 0.003 mg catechin equivalent/g, respectively)[(10-11)].

Adiantum capillus-veneris

The leaves of *Adiantum capillus-veneris* was reported to contain flavonoids like rutin, quercetin, quercetin-3-O-glucoside, querciturone, isoquercitrin, nicotiflorin, naringin, astragalin, populnin, procyanidin, prodelphinidin, and kaempferol-3-sulfate[(12-15)]. The total phenolics and total flavonoids in the leaves were 224.76 and 49.62 in the aqueous extract 156.34 and 78.18, in the methanolic extract and 36.53 and 50.15 mg/100g in the ethanolic extract respectively [(16-17)] .

Agrimonia eupatoria

The flavonoid content of common agrimony herb ranged from 1.22% to 1.40%[(18)]. The flavonoids extracted from the plant were differ according to the source of the plant, Lee *et al.*, isolated ten flavonoids including kaempferol 3-O- -D-(200 - O-acetyl) glucopyranoside, tiliroside, astragalin, apigenin 7-O- -D-glucuronide, rutin, iso- quercitrin, quercitrin, luteolin 7-O- -D-glucur- onide, and luteolin 7-O- -D-glucopyranoside[(19)]. However, the phenols isolated by Zhang *et al.*, were included: apigenin-7-O-3-D-glucopyranoside, catechin, quercetin, rutin, kaempferol-3-O-alpha-L-rhamnoside, Kampferol-3-O-beta-D-glucopyranoside, lutcolin-7-O-beta-D-glucopyranoside, 19alpha, 24-dihydroxy ursolic acid, 3,3'-di-O-mcthyl ellagic acid4-O-beta-D-glucopyranoside [(20-23)].

Ailanthus altissima

The phenolic compounds identified in the plant were gallic acid, chlorogenic acid, HHDP-galloylglucose, epicatechin, rutin, hyperoside and quercetin-3-galloyl hexoside. The amount of total phenolic compounds in ethanolic extract fraction was (12.25%), represented the highest compared with other extract or fractions [24-25]. However, Low *et al*., isolated eight compounds from the flowers of the plant including, brevifolin, brevifolin carboxylic acid, methyl brevifolin carboxylate, ellagic acid, diethyl-2,2',3,3',4,4'- hexahydroxybiphenyl-6,6'-dicarboxylate, rutin, gallic acid, ethyl gallate [26-27].

Alhagi maurorum

Many flavonoids were isolated from *Alhagi maurorum* included, tamarixtin 3-O-dirhamnoside, isorhamnetin 3-O-glucosylneo-hesperidoside, isorhamnetine 3-O-robinoside, isorhamnetin 3-O- rotinoside, quercetin 3-O-rhamnoside, kampferol 3-O-galactoside, quercetin 3, 7-diglycoside, isorhamnetin 3-rutinoside, daidzein 7, 4 -dihydroxyisoflavone, calycisin 3 -hydroxyformononetin, and isorhamnetin [28]. However, the highest total phenolics and flavonoids (mg/g) contents were observed in leaves extract (50.39 and 39.24 respectively), followed by flowers extract (32.00 and 18.50, respectively) [29-30].

Allium species

Kaempferol 3-*O*-[2-*O*-(*trans*-3-methoxy-4-hydroxycinnamoyl)-β-D-galactopyranosyl]-(1→4)-*O*-β-D-gluco-pyranoside, and kaempferol 3-*O*-[2-*O*-(*trans*-3-methoxy-4-hydroxycinnamoyl)-β-D-glucopyranosyl]-(1→6)-*O*-β-D-glucopyranoside were isolaterom bulbs of *Allium porrum* [31-32]. The total flavonoids contents of *Allium schoenoprasum* were 16.7 mg/10/g fresh weight. The ratio of the kaempferol glucoside, quercetin glucoside and isorhamnetin glucoside was found to be 4:1:2. Eight anthocyanins have been determined in acidified methanolic extract of the pale-purple flowers of chives. Four of them have been identified as the anthocyanin-flavonol complexes and phenolic acids such as caffeic, chlorogenic, ferulic, sinapic, p-coumaric, vanillic and syringic [33-37]. The total phenol compounds in *Allium porrum* ranged from 41.6 to 88.2 mg/100 g fresh weight. The green leaves of *Allium porrum* mainly contain kaempferol glycoside and traces of quercetin-3-glucoside (0.10 mg/100 g). However , five flavonoid glycosides were also isolated from *Allium porrum* including kaempferol 3-O-[2-O-(trans-3-methoxy-4-hydroxycinnamoyl)-beta-D-galactopyranosyl] -(1-->4) -O-beta-D-glucopyranoside, and kaempferol 3-O-[2-O-(trans-3-methoxy-4-hydroxy cinnamoyl) -beta-D-glucopyranosyl]-(1-->6)-O-beta-D-glucopyranoside[37-38].

Aloe vera

The total phenolic of ethanol extract of *Aloe* flowers was 17.52 ± 1.34 mg GAE/100 g of dry mass and the total flavonoid was 13.20 ± 0.09 mg CE/100 g of dry mass[39-40].

Alpinia galanga

Many flavonoids were extracted from *Alpinia galangal,* included galangin and alpinin .The rhizome also contains flavonoids, identified as kaemperol, kaempferide, galangin, alpinin and quercetin[41-44].

Althaea officinalis

hypolaetin-8-glucoside, isoquercitrin, kaempferol, caffeic, p-coumaric acid, ferulic acid, p-hydroxybenzoic acid, were isolated from the plant[45-52].

Althaea rosea

Althaea rosea var. nigra. contained, cinnamic (ferulic, *p*-coumaric, caffeic), benzoic (*p*-hydroxybenzoic, vanillic, syringic) acids and *p*-hydroxyphenylacetic acid. The total content of phenolic acids in whole flowers was 60 mg%, in petals , 120 mg% and 30 mg% in calyxes[53-54].

***Ammi* species**

Two flavonoids were isolated from *Ammi majus* fruit, quercetin and kaempferol. The amount of kaempferol (0.045 %) was higher than quercetin(0.036 %)[55-56]. Quercetin, rhamnetin, isorhamnetin, rhamnazin, 3-O-glucosides isorhamnetin, rhamnazin, 7-O-glucoside of isorhamnetin, 3-O-rutin of quercetin, and quercetin 7,3,3'-O-triglucoside were isolated from *Ammi visnaga* [57-58].

Ammannia baccifera

The stem and leaves of *Ammannia baccifera* contained tannin, flavonoids and phenols. The total tannin was 4.141%, while, the total phenols was 3.53 %[59-61].

Anagallis arvensis

The amounts of flavonoids and tannins in the seeds of *Anagallis arvensis* were 4.43±0.10 and 9.56±0.03% respectively [62-64].

***Anchusa* species**

The total phenolic contents of *Anchusa italica* aqueous extract was 12.3 and in methanolic extract was 16.2 (Gallic acid equivalents per g dry weight). The total phenolic contents of *Anchusa strigosa* aqueous extract was 12.3 and in methanolic extract was 16.2 (Gallic acid equivalents per g dry weight) [65-66].

Anethum graveolens

The total phenol and total flavonoid contents of *Anethum graveolens* extract were 105.2 mg of gallic acid equivalents/g of the dried extract and 58.2 mg of catechin equivalents/g of the dried extract, respectively[67-68].

Anthemis nobelis

Flavonoids: apigenin, luteolin, quercetin and their glycosides (apiin, luteolin-7-glucoside and rutin) were isolated from *Anthemis nobelis*[69-71].

Antirrhinum majus

Polyphenols (caffeic acid, chlorogenic acidm and tannin in addition to flavonoids (cyanidin 3-rutinoside, pelargonidin 3-rutinoside, quercetin 3-glucoside, quercetin 3-rutinoside, kaempferol 3-glucoside,kaempferol 3,7-diglucoside,apigenin 7-glucuronide, apigenin 7,4'-diglucuronide, luteolin 7-glucuronide, chrysoeriol 7-glucuronide,naringenin 7-glucoside, naringenin 7-rhamnosylglycoside) were isolated from *Antirrhinum majus*[72-73].

Apium graveolens

The methanolic extract of seeds of *Apium graveolens* contained phenols, flavonoids, and tannins[74]. Phenols content of *Apium graveolens* was (155.41-177.23 mg /100g) included graveobioside A and B, apiin, apigenin, isoquercitrin and tannins (3.89-4.39 mg /100 g) [75-77].

Arachis hypogaea

Eight flavonoids were isolated from water-soluble fraction of peanut skins[78]. Ten proanthocyanidins were isolated from peanut, included epicatechin, proanthocyanidin monomers, dimers, trimers and tetramers[79-79].

Arctium Lappa

It contained many phenolics included caffeic acid, chlorogenic acid, cynarin, arctiin, luteolin and quercetin rhamnoside and tannis[80-81].

Artemisia campestris

Four flavanones (pinostrobin, pinocembrin, sakuranetin and naringenin), one dihydroflavonol (7-methyl aromadendrin) and one flavone (hispidulin) were isolated from *Artemisia campestris*[82-83]. Phenolic derivatives included dihydroquercetin-7,3′-dimethyl ether and three acetophenone derivatives were isolated from the hexane extract of *Artemisia campestris* [84-86].

Arundo donax

The phenolic group content of *Arundo donax* was (0.23−0.27%) [87-89].

Asclepias curassavica

Flavonols, flavonol glycosides, and polyphenolic compounds were isolated from *Asclepias curassavica*. The polyphenols isolated from the plant included quercetin, kaempferol, rutin and isorhametin. [90-96].

Asparagus officinalis

Flavonoids: (quercetin, rutin hyperoside, and isoquercitrin) [97-99] were isolated from *Asparagus officinalis*. The most abundant was rutin , it represented 60-80% of the total phenolic content of purple and green asparagus extracts [100].

Asperula arvensis

Nine flavonol glycosides were isolated from the aerial parts of *Asperula arvensis*, included quercetin, quercitrin, hyperin and isorhamnetin derivatives[101] .

Asplenium ruta-muraria

Caffeic acid glycoside, 2-O-caffeoyl-β-D-fructofuranosyl-(2→1)-α-D-glucopyranoside and an (α, β)-isomeric pair of 2E-caffeoyl-D-glucopyranoside, together with kaempferol-3-O-β-D-[6-E-caffeoyl-β-D-glucopyranosyl-(1→2)glucopyranoside]-7-O-β-D-glucopyranoside, 1-O-caffeoyl glycoside, were isolated from *Asplenium ruta-muraria* [102].

Asplenium trichomanes

Asplenium trichomanes contained phenolic compound included kaempferol 3-O-a-[2'acetyl]-arabinofuranosyl-7-O-a-L-rhamnopyranoside and quercetin 3-methyl ether 5-Glucoside [103-105].

Astragalus hamosus

The plant contained flavonols including hyperoside , isoquercitrin , astragalin and rhamnocitrin 4'-beta-D-galactopyranoside[106-107].

Atriplex hortensis

Atriplex hortensis contained quercetin, kaempferol, isorhamnetin, patulletin, spinacetin, tricin, and quercetin and kaempferol derivatives [108-109] .

Avena sativa

Oat contained 196.1 ug/g polyphenols , 83.5 mg/100g anthocyanins, and 17.7 mg /100g flavonoids [110]. Flavonoids isolated from the plants were included apigenin type flavones: C-glycosyl-apigenins, isovitexin and its 2″-O-arabinoside, 2″-O-glycosides of vitexin and di-C-glucosyl-apigenin and luteolin and its derivatives [111-113].

Bacopa monnier

The total phenolic content of aqueous extract of *Bacoapa monnier* was 58 mg GAE/g[114-115].

Ballota nigra

The aerial part contained flavonoids: apigenin-7-glucoside, vicenin-2 , tangeretin, luteolin-7-lactate and luteolin-7-glucosyl-lactate. Various polyphenols were also isolated from *Ballota nigra* [116-117].

Bellis perennis

Flavonoids contents of *Bellis perennis* was varied from 0.31 to 0.44 mg QE/100 mg dry weight. Total phenolics ranged from 2.81 to 3.57 mg gallic acid equivalent/100 mg dry weight[118-119]. The phenolic compounds of *Bellis perennis* included flavonoids (quercetin, apigenin, kaempferol, isorhamnetin, and their derivatives), phenolic acids (caffeic, ferulic, sinapic, p-coumaric, and salicylic acids), anthocyanins, and tannins [120-126].

Betula alba

The leaves contained 1-3% of flavones glycosides, basically hyperoside and other quercetin glycosides together with glycoside of kaempferol and myricetin and other phenolic compounds, 3,4- dihydroxy propiophenone 3-glucoside, caffeic acid and chlorogenic acid[127-130].

Bidens tripartite

The main flavonoid constituents of the plant extracts were 7-Oglucosides of isookanin, cynaroside, and luteolin. The flavonoid contents, were 1.85% in the herb and 0.92% in the flowers[132-135].

Brassica nigra

Total phenol content of methanol extract was 171.73± 5.04 GAE and the total flavonoid content was 7.45 ± 0.0945 QE. The predominant phenolic compounds determined by HPTLC were gallic acid, followed by quercetin, ferulic acid, caffeic acid and rutin [136].

Brassica rapa

Flavonoids and hydroxycinnamic derivatives were identified in Brassica rapa. These included isorhamnetin, kaempferol, and quercetin glycosides and hydroxycinnamic derivatives[137-138].

Bryonia dioica

After flowering the total phenolic contents in the stem, leaves and flowers were 47.66, 186.34 and 226.57 µg/mg in polar subtraction and 62.05, 203.21 and 241.32 µg/mg in nonpolar subtraction respectively[139]. The total flavonoids of shoots extract reached 2412.2 ± 123.5 mg/kg fresh weight. They included apigenin-*C*-hexoside-*O*-rhamnoside hexoside 24.7±0.1, kaempferol 3,7-di-*O*-rhamnoside 82.6 ± 3.6, apigenin-6-*C*-glucoside 318.4 ± 41.5, luteolin-6-*C*-glucoside 279.0 ± 3.4, apigenin -6-*C*-glucoside-7-*O*-glucoside 1551.7±67.0 and luteolin-6-*C*-glucoside-7-*O*-glucoside 155.9 ± 15.4 mg/kg fresh weight[140] .

Bryophyllum calycinum

The leaves contained flavones, falvans, flavanones, isoflavonoids, anthocyanidines, 5 Methyl 4, 5, 7 trihydroxyl flavone 1, 4, 3, 5, 7 tetrahydroxy 5-methyl 5-propenamine anthocyanidines, isorhamnetin -3-O-a-L-1C4-rhamnopyranoside, 40-methoxy-myricetin-3-O-a-L 1C4-rhamnopyranoside and protocatechuic-40-O-b-D-4C1-gluco-pyranoside[141-145].

Caesalpinia crista

The methanolic extract (100 mg) yielded 50.23 ± 0.003 mg/ml gallic acid equivalent phenolic content and 106.83 ± 0.0003 mg/ml quercetin equivalent flavonoid content [146]. However Jana *et al*., found that the total phenols were (24.66 mg gallic acid equivalent/g dried extract) and flavonoids (136.65 mg quercetin equivalent/g dried extract) [147-148].

Calendula officinalis

The total polyphenol, flavonoid and quercetin concentration of the 2% flowers extract were 313.40, 76.66, and 19.41 mg/g, respectively. The total polyphenols, total flavonoids, rutin and narcissin contents of *Calendula officinalis* were 28.6, 18.8, 1.6 and 12.2mg/g, respectively [149-152].

Calotropis procera

The estimated amount of phenols, flavonoids and tannins in the methanol extract of flowers were 5.2, 7.8 and 4.2 mg/g respectively[153-154]. Four flavonoid glycosides were isolated from the crude methanolic extract of *Calotropis procera*[155-157].

Canna indica

The flavonoids contents of the seeds methanolic extract were 4.76µg/g, the total polyphenols contents were 13.79 µg/g. Four anthocyanins have been isolated from the red flowers of *Canna indica*, identified as cyanidin-3-O-(6"-O-α-rhamnopyranosyl)-β-glucopyranoside, cyanidin-3-O-(6"-O-α-rhamnopyranosyl)-β-galactopyranoside, cyanidin-3-O-β-glucopyranoside and cyanidin-O-β-galactopyranoside [158-159].

Capparis spinosa

Systematic fractionation of *C. spinosa* fruit fractions led to identification of 13 compounds. Major compounds found in the bioactive fraction were flavonoids, and phenolic acids [160-161]. The aerial parts contained rutin as the dominant flavonoid [162]. Leaves and flowers of *Capparis spinosa* were rich in either polyphenols or flavonoids while roots were the poor [163]. Quercetin was quantitatively determined in different plant parts of *C. spinosa* at the mature fruiting stage. The quercetin contents varied from 1.7 mg/g to 12.8 mg/g among different parts of caper. Flower, floral bud and fruit had higher content of quercetin respectively[164]. Leaves had higher

rutin contents among all other parts [165]. Rutin, quercetin, quercetin 3-O-glucoside, quercetin 3-O-glucoside-7-O-rhamnoside, quercetin 3-O-[6'''-α-L-rhamnosyl-6''-β-D-glucosyl]-β-D-glucoside, and kaempferol glycosides were isolated from *C. spinosa* [166-167].

Capsella bursa-pastoris

Nine flavonoids were isolated from *Capsella bursa-pastoris*, their structures were identified as tricin, kaempferol, quercetin, and their derivatives[168-169]. The amounts of these flavonoids in the methanol and methanol/water extracts (mg/kg dry plant) were: quercetin-6-*C*-glucoside 793.90±8.80 and 564.32±8.09, quercetin -3-*O*-glucoside 426.26±1.01 and 1241.25±37.61, kaempferol-3-*O*-rutinoside 2314.61± 11.59 and 2179.57±67.68, quercetin 16.36±0.59 110.86±15.69 and kaempferol 16.01±0.12 and 130.41± 12.27 respectively [170-171].

***Capsicum* species**

The total flavonoid contents ranged from 25.38 ±3.44 to 60.36 ±9.94 mg quercetin equivalents /100g fresh weight. Nine phenolic compounds were determined in the plant extract [172-174]. The total phenolic contents (µg GAE /g FW) of *Capsicum annuum var frutescens*: green 1012.02±12.56, yellow 1292.03±19.34 and red 2150.25±24.37. The total phenolic contents of *Capsicum annuum var. glabriusculum*: green 1206.25±15.34, yellow 1919.45±24.27 and red 3114.58±25.29. While, the total phenolic contents of *Capsicum annuum*: green 1205.54±16.43, yellow 2600.07±22.26 and red 4135.45±33.33 [175-176].

Carthamus tinctorius

The total phenolic contents were 126.0 (mg, GAE/g), and the total flavonoid contents were 62.2 (mg, QE/g). Phenolic compounds identified in *Carthamus tinctorius* seed extract were included (mg/g) hydroxybenz-hydrazide derivative 18.2, amino-3,4-dimethylbenzoic acid 16.8, chlorogenic acid 2.4, syringic acid 0.2, p-coumaric acid 0.5, trans-Ferulic acid 3.0, gallocatechin 17.0, -(−)epigallocatechin 109.6, epigallocatechin gallate 1.1, quercetin dehydrate 2.2, kaempferol 0.8, rutin hydrate 3.7, luteolin 1.6, naringin 6.0 and trans-chalcone 2.1[177-181].

Carum carvi

The flavonoid constituents of caraway were included quercetin-3-glucuronides, isoquercitrin, quercetin 3-0 caffeylglucoside, and kaempferol 3-glucoside [182-183].

Cassia occidentalis

Cassia occidentalis extract contained total flavonoids 3.24µg/g, carotenoids 2.9µg/g and total phenolics 6.7µg [184]. 5, 7-dihydroxyflavone-5-O-β-d-xylopyranosyl-7-O-α-l-rhamnopyranosyl-(1→3)-O-α-l-arabinopyranoside; 3, 5, 7, 3' ,4'-pentahydroxy flavone-3-O-α-l-rhamnopyranosyl-7-O-β-d-glucopyranosyl-(1→3)-O-β-d-xylopyranoside and 5, 7, 3', 4'-tetrahydroxy-6-methoxyflavone-5-O-α-l-arabinopyranosyl-(1→4)-O-α-l-rhamno pyranosyl-(1→3)-O-β-d-galactopyranoside were isolated from *Cassia occidentalis* [185-186].

Casuarina equisetifolia

Eight phenolic compounds were isolated from the leaves (gallic, protocatioic, chlorogenic, syringic, p.hydroxy benzoic, p-coumaric, vanillic and salicylic acid). Gallic, salicylic and protocatioic were presented in high concentrations (19.18, 11.57 and 6.84 µg/g, respectively). The concentration of other phenolic compounds ranged from 1.63 to 4.70 µg/g. The least concentration was chlorogenic with 1.63 µg/g [187]. The methanolic extract of *Casuarina equisetifolia* leaves contained (mg/100 g): rutin 834.6, rosmarinic 384.6, quercitin 837.9, hesperetin 206.2, narenginin 384.8, apignen 59.9 and kampferol 399.2[188-192].

Celosia cristata

The total polyphenols, flavonoids and tannin contents of methanolic extracts on the cockscome flowers were 6.80, 2.34 and 6.23mg/g extract residue, respectively [193]. The changes of flavonoid compounds in Flos *Celosiae cristatae* were determined after carbonizing processed. Among the ten batches of processing samples, these components were not determined in two batches, but were found in the other eight bathes, with the content of kaempferol as 0.002 -.025 % and isorhamnetin as 0.001 -0.011 % [194-196].

Centaurea cyanus

Various flavonoids were isolated from *Centaurea cyanus* including apigenin-4'-O-(6-O-malonil-glucoside)- 7-O-glucuronide, apigenin-4-O-glucoside, apigenin-7-O-glucoside (cosmosiin), apigenin-7-O apio- glucoside (apiin), methyl-apigenin and methyl-vitexin, cyanidin-3-O-succinyl-glucoside- 5-O-glucoside (centaurocyanin) , cyanidin-3,5-diglucoside (cyaniding), 5-methoxy-apigenine (hispidulin), quercetin-3-O-gluco- rhamnoside (rutoside), rhamnetin, isorhamnetin, isorhamnetin-7-O-glucoside, naringenin, kaempferol-glycosides, luteolin-glycosides, quercetin, naringin, naringenin-7-O-gluco-rhamnoside, quercetin-3-glucorhamnoside, apigenin-7-glucoside, quercetin-7-glucoside, quercetin -3-glucoside, apigenin-8-C-glucoside, aringenine, caffeic, chlorogenic, neochlorogenic acids and umbeliferone [197-202].

Chenopodium album

Analysis of the leaves of four *Chenopodium album* cultivars showed that they contained total phenols 224.99-304.98 mgGAE/100g, simple phenols 72.50-101.007 mgGAE/100g, tannins 152.49- 203.91 mgGAE/100g and flavonoids 220.0-406.67 mg/100g [203-204]. Arora et al found that the polyphenolic and flavonoid content of

different *Chenopodium album* aerial parts extracts were in the range of 14.56±0.21-42.00±0.2mg (gallic acid equivalent/g extract) and 2.20±0.003-7.33±0.5 mg (rutin equivalent/g extract) respectively[205-206].

Chrozophora tinctoria

The methanol extract of the aerial parts of *Chrozophora tinctoria* yielded five flavonoid glycosides, rutin, acacetin 7-*O*-rutinoside, apigenin 7-*O*-β-D-[(6-*p*-coumaroyl)]-glucopyranoside, apigenin 7-*O*- β-D-glucopyranoside and apigenin 7-*O*-β-D-[6-(3,4-dihydroxybenzoyl)] -glucopyranoside (named, chrozophorin) [207-208].

Cicer arietinum

Ferulic, chlorogenic, caffeic, and vanillic acids were the principal phenolic acids found in cotyledons. The most striking difference was the predominance of isoflavones in embryonic axe fractions. The isoflavone genistein was detected in all three fractions of chickpea. Seed coat fractions having higher total phenolic indexes[209-212].

Cichorium intybus

The total flavonoids (TF) and phenolic acids (TPA) content of different parts of *Cichorium intybus* ranged from 0.05 to 0.10 and 0.47 to 2.52 g/100g dry weight respectively[213]. The seeds extract/fractions contained total phenolic (50.8-285 GAE mg/100g of Dry plant matter) and total flavonoid (43.3-150 CE mg/100g of dry plant matter)[214]. Sixty four phenolic acids and flavonoids were extracted from several types of *Cichorium intybus* var. silvestre salads [215-216].

Citrullus colocynthis

The plant contained 0.74% (*m/m*) phenolics (calculated as gallic acid) and 0.13% (*m/m*) flavonoids (calculated as catechin equivalents per 100 g of fresh mass)[217]. Catechic tannins and flavonoids were abundant [218]. Three flavone glucosides, isosaponarin, isovitexin and isoorientin 3'-*O*-methyl ether were isolated from the fruits of *Citrullus colocynthis*[219-220].

Citrus species

Phytochemical analysis showed that *Citrus aurantifolia*, *Citrus limonum* and *Citrus sinensis* fruits contained: flavonoids: 0.29, 0.57, 0.19; tannins: 0.04, 0.01, 0.04 and phenols: 0.02, 0.05, 0.01 mg/ 100g dry weight respectively[221-222].

Citrus sinensis flavonoids: [flavanones (didymin 1.89%, eriocitrin 0.31%, hesperidin 28.6%, narirutin 5.2%); flavones (neoeriocitrin 0.59%, poncirin 1.04%, 6,8-di-C-Glu-apigenin 5.72%, 6,8-di-C-Glu-diosmetin 0.35%, rhoifolin 0.05%, isorhoifolin 0.07%, diosmin 0.09%, neodiosmin 0.08%); polymethoxy flavones (heptamethoxy flavone 0.08%, nobiletin 0.33%, sinensetin 0.37%, tangeretin 0.04%) and aglycones (taxifolin 0.03%, acacetin 0.03%)]. *C limon* flavonoids*:* [flavanones (eriocitrin 16.7%, hesperidin 20.5%); flavones (6,8-di-C-Glu-apigenin1.17%, 6,8-di-C-Glu-diosmetin 4.95%, 7-O-Rut-luteolin 3.93%, diosmin 3.12%), aglycones (luteolin 0.08%)]. *Citrus medica* flavonoids: (hesperidin, eriocitrin, rutin and diosmin and naringin). *Citrus limmeta* flavonoids: (hespiridin, naringin). *Citrus aurantifolia* flavonoids: [flavanones (eriocitrin 0.29%, hesperidin 1.77%, neoeriocitrin 0.01%); flavones (diosmin 0.08%), polymethoxy flavones (heptamethoxy flavone 0.12%, natsudaidain 0.04%, nobiletin 0.52%, tangeretin 0.18%); aglycones (taxifolin 0.04%, luteolin 0.61%)] [223,224-227]. The favonoids composition of *Citrus aurantifolia* juice (mg/100 ml): flavanones (eriocitrin 0.29, hesperidin 1.77, neoeriocitrin 0.01); flavones (diosmin 0.08); polymethoxy flavones (heptamethoxy flavone 0.12, natsudaidain 0.04, nobiletin 0.52, tangeretin 0.18); aglycones (taxifolin 0.04, luteolin 0.61). Flavonoid composition of *Citrus limon* juice (mg/100 ml): flavanones (eriocitrin16.7, hesperidin 20.5); flavones (6,8-di-*C*-Glu-apigenin 1.17, 6,8-di-*C*-Glu-diosmetin 4.95, 7-*O*-Rut-luteolin 3.93, diosmin 3.12); aglycones (luteolin 0.08). Flavonoid composition of *Citrus sinensis* juice (mg/100 ml): flavanones (didymin 1.89, eriocitrin 0.31, hesperidin 28.6, narirutin 5.2); flavones (neoeriocitrin 0.59, poncirin 1.04, 6,8-di-*C*-Glu-apigenin 5.72, 6,8-di-*C*-Glu-diosmetin 0.35, rhoifolin 0.05, isorhoifolin 0.07, diosmin 0.09, neodiosmin 0.08); polymethoxyflavones (heptamethoxy flavone 0.08, nobiletin 0.33, sinensetin 0.37, angeretin 0.04); aglycones (taxifolin 0.03, acacetin 0.03). Flavonoid content of *Citrus aurantifolia* roots, stem, stem bark, leaves and peels were 0.64±0.40, 0.33±0.01, 0.42±0.01, 0.06±0.07 and 0.51±0.02 % respectively. While, the flavonoid content of *Citrus limon* roots, stem, stem bark, leaves and peels were 0.60, 0.34, 0.47, 0.65 and 0.48% respectively. *Citrus sinensis* roots, stem, stem bark, leaves and peels showed 0.63, 0.29, 0.38, 0.63 and 0.35% flavonoids content respectively[228-230].

Clerodendrum inerme

The leaves yielded the flavanolid, friedelin, salvigenin (5-hydroxy-6, 7, 4'- methoxy flavones), acacetin, cirisimaritin, pectolinarigenin, apigenin (5, 7-dihydroxy-4' mathoxy flavaone) and amethyl flavones, cleroflavone (7-hydroxy 5, 4' dimethoxy-6-methyl flavanone) [231-232].

Clitoria ternatea

The total phenolics, flavonoids and anthocyanins contents in the aqueous extract of *Clitoria ternatea* flower were 53 ± 0.34 mg gallic acid equivalents/g dried extract, 11.2 ± 0.33 mg catechin equivalents/g dried extract, and 1.46 ± 0.04 mg cyanidin-3-glucoside equivalents/g dried extract, respectively[233-234]. The flowers contained flavonoids. They were characterized as quercetin 3-(2(G)- rhamnosylrutinoside)s, kaempferol, quercetin,

myricetin 3-neohesperidosides, 3-rutinosides, and 3-glucosides. In addition, the presence of myricetin 3-O-(2"-O-alpha-rhamnosyl-6"-O-malonyl)-beta-glucoside was inferred from LC/MS/MS data for crude petal extracts [238-240].

Cnicus benedictus

The plant contained phenol compound, flavonoids, including apigenin-7-O-glucoside, luteolin and astragalin**.** Tannins contents reached (8%)[241-243].

Colchicum balansae

Twenty phenolic compounds were also identified in extracts from five *Colchicum* species [244-246].

Convolvulus arvensis

Total phenolics and total flavonoids were 244.6 and 174.4 mg gallic acid and rutin equivalents per gram extract, respectively. Protocatechuic, caffeic, chlorogenic, gentisic, p-coumaric, p- hydroxybenzoic, p-hydroxyphenylacetic, ferulic, vannilic, syringic, benzoic and salicylic acids were detected in the phenolic acids fraction. Flavonoids including kaempferol, quercetin and their glycosides were isolated from the plant[248-254].

Corchorus capsularis

Flavonoids (quercetin), was isolated from root extract of *Corchorus capsularis*[255-256].

Cordia myxa

The total phenol contents of *Cordia myxa* fruits was 373.91 ± 13.93 mg/100g dry weight, and antioxidant activity (IC_{50}) was 132.53 ± 5.75 µg/ml[257-259].

Coriandrum sativum

Caffeic acid, protocatechinic acid, and glycitin were characterized as the major polyphenolics of coriander aerial parts. The ethanolic extract of coriander seeds contained many flavonoids including caffeic acid, chlorogenic, quercetin and rutin. However, the total polyphenolic content of the seeds was found to be 12.2 gallic acid equivalents (GAE)/g while total flavanoid content was found to be 12.6 quercetin equivalents/g. The amount of flavonoids in 70% ethanol extract was found to be 44.5 µg and that of the total phenols was 133.74 µg gallic acid equivalents per mg of the hydro-alcohol extract of *Coriandrum sativum* leaves[260-262].

Coronilla varia

Total number of flavonoids in *Coronilla varia* leaves was five, (four flavonoid sulphates and one flavone glucosides)[263]. The condensed tannin (Proanthocyanidins) concentration in *Coronilla varia* was 16.0 (g/ kg of dry weight)[264-266].

Cressa cretica

Sunita and Jha isolated nine compounds included three coumarins and four flavonoids from *Cressa cretica*. Their structure established as coumarin, umbelliferone, daphnetin, quercetin, kaempferol, quercetin 3-O-b-D-glucoside, quercetin-3-O-a-L-rhamno-(1→6)-b-D-glucoside, stigmasterol and b-sitosterol[267]. The aerial parts of *Cressa cretica* yielded five flavonoids that were identified as quercetin, quercetin-3-*O*-glucoside, kampferol-3-*O*-glucoside, kampferol-3-*O*-rhamnoglucoside, and rutin[268]. The extract of *Cressa cretica* was also shown to have high phenolic content, 99.09±0.10 µg/mg[269-270].

Crocus sativus

The phenolic and flavonoid compounds of saffron stigma were examined using reversed phase (RP)-HPLC. The total phenolics value for methanolic saffron extract was 6.54 ± 0.02 mg gallic acid equivalent (GAE)/g dry weight (DW), and the total flavonoids were 5.88 ± 0.12 mg rutin equivalent/g DW[271]. Total phenolic content (TPC) of the methanolic extract of *Crocus sativus* flowers was 86.65 mg/g gallic acid equivalents[272-273].

Crotalaria juncea

The preliminary phytochemical screening of the *Crotalaria juncea* leaves revealed the presence of phenolics, flavonoids, and tannins [274-277].

Cuminum cyminum

Flavonoid glycosides isolated from the plant were included apigenin-7-glucoside, luteolin-7-glucoside, luteolin-7-glcuronosyl glucoside, luteolin and apigenin[278]. Total polypheols in cumin were 4.98± 0.31. (mg GAE/g DW)[279]. Phenols (salicylic acid, gallic acid, cinnamic acid, hydroquinone, resorcinol, P-hydroxybenzoic acid, rutin, coumarine, quercetin) were isolated from seeds of *Cuminum cyminum*[280-283].

Cupressus sempervirens

The preliminary phytochemical analysis showed that the plant contained flavonoids 0.22%, tannin 0.31% and phenols 0.067%[284-285]. However, the total phenols content of *Cupressus sempervirens* fresh leaves was 4.35 (mg gallicacid/g extract) and the total flavonoids was 9.5 (mg quercetin/g extract)[286-287].

Cuscuta planiflora

The plant contained polyphenols and flavonoids[288]. The poly-phenolic content of the hydroalcoholic and chloroform extracts were 10.64 ± 0.86 and 4.81 ± 0.38, respectively[289-290].

Cydonia oblonga

Cydonia oblonga leaves of 36 samples from three different geographical origins were tested for phenolic compounds, nine phenolic compounds were isolated including 3- O-, 4- O- and 5- O-caffeoylquinic acids, 3,5-

O-dicaffeoylquinic acid, quercetin-3- O-galactoside, quercetin-3- O-rutinoside, kaempferol-3- O-glycoside, kaempferol-3- O-glucoside, and kaempferol-3- O-rutinoside. 5- O-caffeoylquinic acid, represented the major phenolic compound, followed by quercetin 3- O-rutinoside. Quince leaves are characterized by higher relative contents of kaempferol derivatives than fruits (pulps, peels, and seeds), especially in what concerns kaempferol-3- O-rutinoside (12.5%). *Cydonia oblonga* leaves total phenolic content was varying from 4.9 to 16.5 g/kg dry matter [(291)]. Quince seeds presented a phenolic profile composed of 3-O-caffeoylquinic, 4-O-caffeoylquinic, 5-O-caffeoylquinic and 3,5-dicaffeoylquinic acids, lucenin-2, vicenin-2, stellarin-2, isoschaftoside, schaftoside, 6-C-pentosyl-8-C-glucosyl chrysoeriol and 6-C-glucosyl-8-C-pentosyl chrysoeriol. Six identified organic acids constituted the organic acid profile of quince seeds: citric, ascorbic, malic, quinic, shikimic and fumaric acids[(292-294)]. The total phenolic content of *Cydonia oblonga* aqueous acetone extracts of the pulp and peel parts ranged from 37 to 47 and 105 to 157 mg/100 g of fresh weight, respectively. Chlorogenic acid (5-O-caffeoylquinic acid) was the most abundant phenolic compound in the pulp (37%), whereas rutin (quercetin 3-O-rutinoside) was the main one in the peel (36%)[(295-296)].

Cymbopagon schoenanthus

Cymbopogon schoenanthus contained flavonoids such as tricin, flavones C-glycosides, luteferol and apigiferol[(297-298)].

Cynodon dactylon

HPLC–ESI MS have identified the presence of many flavonoids including apigenin, luteolin, 6-C-pentosyl-8-C-hexosyl apigenin and 6-C-hexosyl-8-C-pentosyl luteolin[(299-300)].

Cyperus rotundus

Cyperus rotundus contained flavonoids (visnagin, khellin, ammiol, isorhamnetin, and tricin) and phenolic acids (salicylic acid, protocatechuic acid, caffeic acid and *p* coumaric acid)[(301)]. Total flavonoids contents in methanol extracts of *Cyperus rotundus* (8.15-18.25 mg CE/g of dry matter) were higher as compared to ethanol extracts (6.44-13.77 mg CE/g of dry matter). Total phenolic contents in methanol extracts of *Cyperus rotundus* (27.40-37.85 mg GAE/g of dry matter) were also higher as compared to ethanol extracts (25.21-30.23 mg GAE/g of dry matter)[(302-303)].

Dactyloctenium aegyptium

Dactyloctenium aegyptium extract revealed the presence of phenolics , flavonoids and tannins [(304)].

Quantitative analysis showed that *Dactyloctenium aegyptium* leaf extract contained phenols 0.246 ± 0.041, and tannins 0.430 ± 0.032 mg/g dry weight [(305)].

Dalbergia sissoo

Sissotrin, biochanin, dalbergenone, dalbergin, methyl dalbergin, A 7-O-[beta-D-apiofuranosyl-(1-->5)-beta-D-apiofuranosyl-(1→6)-beta-D-glucopyranoside] and tectorigenin 7-O-[beta-D-apiofuranosyl-(1→6)-beta-D-glucopyranoside], were isolated from *Dalbergia sissoo* [(306-310)]. Total phenolic contents of the various extracts of *Dalbergia sissoo* were estimated as 50.8 mg/g[(311)]. However, Kumari and Kakkar found that the total phenolic was 58.06 GAE mg/g of extract and tannin content was varied from 218.34 to 61.75 mg catechin equivalent (CE)/g of extract[(312-313)].

Daphne mucronata

Many chemical compounds were isolated from *Daphne mucronata*. These included Cinnamic acid and flavanoids: 5,7,3',4'- Tetrahydroxyflavone, 5,3',4'- Trihydroxyflavone 7- O-β-; 5,6,7,8,3',4'- Hexamethoxyflavone; 5-Hydroxy-3,6,7,4'- Tetrahydroxyflavone[(314-317)].

Datisca cannabina

The major flavonoids in *Datisca cannabina* were included datiscetin 3-rutinoside and galangin 3-rutinoside. Kaempferol, quercetin and galangin were also isolated from the plant exist. Gallic acid and ellagic acid were also isolated[(318-322)].

***Datura* species**

The amount of total phenolic content (TPC) and total flavonoid contents (TPC) of *Datura metel* were analysed. The highest TPC was determined in methanolic extracts of seed (268.6 µg of gallic acid equivalence/ mg of dry plant material) and the highest TPC was determined in fruit pulp (8.84 µg of quercetin equivalence/mg dry plant material)[(323-324)].

Phytochermical analysis showed that the aqueous and ethanolic extract of the stem-bark of *Datura stramonium* contained flavonoids and phenols[(325)].

Daucus carota

Daucus carota roots extracts showed that it contained flavonoids, phenols, and coumarin[(326)]. Flavonols (quercetin, kaempferol, rutin or quercetin 3-rutinoside) and flavones (apigenin, luteolin and chrysin) were identified from different parts of carrot[(327-329)]. Three flavones included luteolin, luteolin 3'-O-beta-D-glucopyranoside and luteolin 4'-O-beta-D-glucopyranoside were isolated from the methanol extract of *Daucus carota* seeds[(330-332)].

Delphinium ajacis

The preliminary phytochemical analysis of *Delphinium ajacis* revealed the presence phenolics, flavonoids and tannins[333-335].

Desmostachia bipinnata

Phytochemical analysis of the plant resulted in isolation of coumarins (scopoletine and umbelliferone), tannins, phenolics and flavonoids[336-338]. Five flavonoid glycosides were isolated from the ethanol extract of *Desmostachia bipinnata*. They were identified as kaempferol, quercetin, quercetin-3-glucoside, trycin and trycin-7-glucoside[339-340].

Dianthus caryophyllus

Three flavonoids, apigenin-C-glycoside, kaempferol 3-O-β-d-glucopyranosyl-(1→2)-O-[α-l-rhamnopyranosyl-(1→6)]-β-d-gluco-pyranoside and kaemp-ferol 3-O-[α-l-rhamnopyranosyl-(1→6)]-β-d-glu-copyranoside, were isolated as the main flavonoidal components in nine different cultivars [341-342]. Two benzoic acid derivatives, protocatechuic acid (3,4- dihydroxybenzoic acid) and vanillic acid (4-hydroxy-3-methoxybenzoic acid), flavonol glycoside peltatoside (3-[6-O-(alpha-L-arabinopyranosyl)-beta-D-glucopyranosyl] quercetin) and flavone datiscetin (3,5,7,2'-tetrahydroxyflavone) were isolated from the plant[343]. Kaempferide triglycoside, was isolated from *Fusarium* resistant varieties of *Dianthus caryophyllus* [344-345].

***Dodonaea viscos*a**

The plant contained many flavonoids, aliarin, pinocembrin, penduletin; viscosol; sakuranetin; isokaempferide. Ten new isoprenylated flavonol derivatives, dodoviscins A-J; 5,7-dihydroxy-3'-(4"-acetoxy-3"-methylbutyl)-3,6,4'-trimethoxy flavones; C-alkylated flavonoids 5,7-dihydroxy-3'-(3-hydroxymethylbutyl)-3,6,4'-trimethoxyflavone, 5,7,4'-trihydroxy-3'-(3-hyroxy methyl butyl)-3,6-dimethoxyflavone; 5,7-dihydroxy-3'-(2-hydroxy-3-methyl-3-butenyl)-3,6,4'-trimethoxy flavones (4),5,7,4' -trihydroxy-3,6-dimethoxy-3'-isoprenyl-flavone; 5,7-Dihydroxy-3,6-dimethoxy-2-(4-methoxyphenyl) -4H-chromen-4-one; Kaempferol methyl ethers, 3, 5, 7-trihydroxy-4'-methoxyflavone; 5, 7, 4'-trihydroxy-3, 6-dimethoxyflavone; 5, 7-dihydroxy-3, 6, 4'-trimethoxyflavone (santin); 5-hydroxy -3, 7, 4'- trimethoxyflavone; 3,4',5,7-tetrahydroxy flavones (kaempferol); 5,7,4'-trihydroxy-3',5'-di(3-methylbut-2-enyl)-3,6-dimethoxyflavone and 5,7,4'-trihydroxy-3'-(4-hydroxy-3-methylbutyl)-5'-(3-methylbut-2-enyl)-3,6- Dimethoxyflavone; acacetin-7-Me ethers the flavonol-3-methyl ethers 4',5,7-trihydroxy-3,6-dimethoxyflavone, penduletin; 3, 6, 4'-trimethoxy-5,7-dioxyflavone; kaempferol 3,7-di-methyl ether and kaempferol-3,4',7- trimethyl ether were isolated from the aerial parts. Isorhamnetin and quercetin were isolated from the root bark of *D viscos*a. Catechin or chromene groups, chalcones with trimethoxyphenyl group and tannin with 4-O-β-D-xylopyranoside were isolated from the leaves of *Dodonaea viscosa* var. angustifolia[346-359].

Echinochloa crus-galli

Total phenolic and total flavonoid contents of 1% acidified methanol extract of seeds of *Echinochloa crus-galli* were 1.2083 GAE/g and 845.33 Qu.E/g [362]. The methanol macerated extract contained maximum total phenolic content (0.719 ± 0.67 mg GAE/g) than other extract by soxhlation. Eleven compounds identified by chromatographic techniques in the plant. The dominant phenolic compounds were flavonoids and phenol carboxylic acids including myricetin, quercetin, artemisinin, cyanidin, kaempferol, luteolin, 5,7-dihydroxy-3',4',5'-trimethoxy flavones, bilobol and its derivatives[363-364].

Echium italicum* and *E. vulgare

The total phenolic content of the herb and root of *Echium italicum* and *E. vulgare* was 11.46 ± 0.08 and 19.97 ± 0.01 mg GA/g respectively, while, the total flavonoit content of the herb and root of *Echium italicum* and *E. vulgare* were 19.97 ± 0.01 and 47.11 ± 0.01 mg Quercetin /g respectively[365-366].

Ephedra alata* and *Ephedra foliata

Flavonoid isolated from *Ephedra alata* were included vicenin II, lucenin III, kaempferol 3-rhamnoside, quercetin 3-rhamnoside, herbacetin 7-glucoside, herbacetin 8-methyl ether 3-O- glucoside-7-O-rutinoside and herbacetin 7-O-(6″-quinylglucoside. The total phenolic content was highest in the methanolic extract (47.62 mg gallic acid equivalent/g of extract powder), while in ethanolic extract, the total phenolic content was 19.175 mg GAE/g of extract powder. The total flavonoid content of the plant was 0.519 mg rutin /g in the aqueous extract and 5.44 mg RU/g in the ethanolic extract while was the highest in the methanolic extract 54.66 mg rutin /g[367-370].

Equisetum arvense

The plant contained 0.6 to 0.9% flavonoids including apigenin-5-0-glucoside, genkwanin-5-O-glucoside, kaempferol-3,7-di-0-glucoside, kaempferol- 3-0-(6'-0-malonyl-glucoside)-7-0-glucoside, kaempferol-3-O-sophoroside, luteolin-5-O-glucoside, quercetin-3-O-glucoside [371-375].

Erigeron canadensis

Twelve flavonoids were isolated from ethanolic extract of whole *Erigeron canadensis* and identified as quercetin-7-O-beta-D-galactopyranoside,quercetin, luteolin, apigenin, 5,7,4'-trihydroxy-3'-methoxy flavone, quercetin-3-alpha-rhamnopyranoside, quercetin-3-O-beta-D-glucopyranoside, apigenin-7-O-beta-D-

glucopyranoside, luteolin-7-O-beta-D-glucuronide methyl ester,4'-hydroxy baicalein-7-O-beta-D-glucopyranoside, baicalein and rutin[376-377].

Erodium cicutarium

The total polyphenol content of the dry raw material of *Erodium cicutarium* was 3.41%; flavonoids (calculated as quercetin) represented 0.45% and tannins 0.78%[378]. The major phenolic acids and depsides in methanol extracts extracted from *Erodium cicutarium* were gallic acid 12.40, protocatechuic acid 3.93, gallic acid methyl ester 18.38, brevifolin 25.95 and ellagic acid 11.88 mg per gram of dry weight[379-381].

Eryngium creticum

The highest flavonoids contents was recorded in the ethanolic extract of leaves and stems, while the highest total phenolic content was recorded in the aqueous extract of both leaves and stems[382-383].

Eschscholtzia californica

The aqueous ethanolic extract of aerial parts of *Eschscholtzia californica* yielded six flavonol 3-*O*-glycosides. Flavonoids, in the *Eschscholzia californica*, occurred mainly as quercetin isorhamnetine glycosides[384-386].

Eucalyptus camaldulensis

Total penolics in the *Eucalyptus camaldulensis* leaves was 364.1 ± 8.2 (mg gallic acid equivalent/ g) and total flavonoids was 80.5 ± 0.9 (mg quercetin equivalent/ g) *Eucalyptus camaldulensis* leaves contained many phenolic groups and compounds including ellagitannins, flavonoids, phloroglucinol derivatives and galloyl esters[387-388].

Eupatorium cannabinum

Polyphenolics levels in the aerial parts of *Eupatorium cannabinum* subsp. *cannabinum* (g/kg on dry matter) were: chlorogenic acid 14.67; 3,5 dicaffeoylquinic acid 22.74; 4,5 dicaffeoylquinic acid 4.23; total caffeoyl derivatives 41.64, total dihydroxycinnamic derivatives 65.72 ± 3.37, total flavonoids 8.10 ± 0.41, total dihydoxycinnamic derivatives 73.82 and total polyphenolic compounds 81.47[389]. The total phenol and flavonoid contents were found 64.82 mg/g and 25.05 mg/g gallic acid and quercetin equivalent respectively in the ethanolic extract of the leaves of *Eupatorium cannabinum*[390-393].

Euphorbia hirta

Seven phenolic compounds [(-)-epigallocatechin gallate 16.25- 29.52 mg/100 g dw, (-)-epicatechin gallate 16.72-41.87 mg/100 g dw, luteolin-7-O-glucoside 5.24- 98.83 mg/100 g dw , isoquercitrin 12.30-51.87 mg/100 g dw, syringic 51.14-68.00 mg/100 g dw, chlorogenic 48.68-79.67 mg/100 g dw and caffeic acids 0.66-1.22 mg/100 g dw] , and six sterols [β-sitosterol-D-glucoside 19.08- 45.76 mg/100 g dw, β-sitosterol 1.20-3.56 mg/100 g dw, cholesterol 0.41-3.36 mg/100 g dw, brassicasterol 10.09-32.57mg/100 g dw, campesterol undetected -0.51 mg/100 g dw, stigmasterol 11.69-19.66 mg/100 g dw] were isolated from *Euphorbia hirta*[394-396].

Euphorbia macroclada

The chemical analysis of the whole plant showed the presence flavonoids phenols and tannins. Total phenolic contents of *Euphorbia macroclada* were found to be 7.3 ± 0009 mg CAE/g dry weight in the stem and 10.57±0.037 mg CAE/g dry weight in the leaves[397-399]. Many flavonoids such as kaempferol rhamnoside, quercetin, quercetin-7-O-glucoside, rutin were isolated from the plant[400].

Fagopyrum esculentum

The flavonoids contents were 19.64 µg/250 µg of dry powder (7.856 %). The phenolics contents were 0.80 µg/25.97 µg of dry powder (3.08 %)[401]. The rutin content was higher than quercetin in buckwheat seeds. Rutin content was in the range from 0.05 to 1.35% of buckwheat seeds. Quercetin content varied from 0.01 to 0.17% and in some common buckwheats it was even difficult to detect, hyperoside 0.18- 0.37% and chlorogenic acid 4.09-5.57%[402-403]. Chlorogenic acid, catechin, isoorientin, orientin, rutin, vitexin, and quercitrin were isolated from *Fagopyrum esculentum* [404]. Four catechins and rutin were isolated from ethanol extracts of *Fagopyrum esculentum* groats. The structures of these catechins were established as (−)-epicatechin, (+)-catechin 7-*O*-β-D-glucopyranoside, (−)-epicatechin 3-*O*-*p*-hydroxybenzoate, and (−)-epicatechin 3-*O*-(3,4-di-*O*-methyl) gallate[405-406].

Ficus carica

Total phenolics of fig fruits was 10.90 µg GAE/mg and total flavonoids 2.75 µg CE/ mg[14]. The phenolic contents of five different fig cultivars (Šaraguja, Termenjača, Crnica, Bjelica and Bružetka bijela) were determined as 7.24 to 11.17 mg CAE/g of dry extract[407-409].

Ficus semicordata

Flavonoids (gallocatechin, epigallocatechin, catechin, rutin, quercetin and quercetrin) were also isolated from the plants[18]. The total phenolic and alkaloid contents were studied in the methanol, ethyl acetate and hexane extracts of *Ficus semicordata*. The quantified phenolic content of *Ficus semicordata* leaves extracts were ranging from 16.25±0.22 to 97.02±0.17 mg/gm. The ethanol extract showed more phenolic content 97.02±0.17 mg/gm than other extracts [19]. The dried leaves of *Ficus semicordata* have shown the presence of condensed

tannins (+)-catechins, quercetin and quercitrin[411]. The tannin content of the leaves was high, with a peak in December, and a subsidiary peak in March[412].

Ficus religiosa

The total phenol content present in one milligram of aqueous and ethanolic extracts of the bark was 497.77 and 375.23µg, respectively[413]. The total phenolic contents of absolute ethanol, absolute methanol, aqueous ethanol (ethanol: water, 80:20 v/v) and aqueous methanol (methanol: water, 80:20 v/v) extracts was 3.13 ± 0.19, 5.34 ± 0.36, 2.67 ± 0.16 and 4.11 ± 0.18 (GAE g/100 g of DW) by shaking extraction technique and 2.12 ± 0.09, 4.93 ± 0.28, 2.26 ± 0.10 and 4.13 ± 0.21 (GAE g/100 g of DW) by reflux extraction technique respectively[414].

However, chemical analysis showed that *Ficus religiosa* was rich in flavonoids, quercetin was most abundant 1.428±0.5 - 4.29±0.4 mg/Kg and myricetin was also present in good amounts 0.08± 0.3-1.0± 0.5 mg/kg[415-416].

Foeniculum vulgare

Total phenolic content in organic fennel oil was 262.59 ± 15.5 mg GAE/l [417]. The phenolics identified in the fruit of this plant (%) were neochlorogenic acid (1.40), chlorogenic acid (2.98), gallic acid (0.169), chlorogenic acid (6.873), caffeic acid (2.960), *p*-coumaric acid (4.325), ferulic acid-7-*o*-glucoside (5.223), quercetin-7-*o*glucoside (3.219), ferulic acid (3.555), 1,5 dicaffeoylquinic acid (4.095), hesperidin (0.203), cinnamic acid (0.131), rosmarinic acid (14.998), quercetin (17.097), and apigenin (12.558)[418]. Parejo *et al.*, isolated 3-caffeoylquinic acid, 4-caffeoylquinic acid, 1.5-Odicaffeoylquinicacid, rosmarinic acid, eriodictyol-7-Orutinoside, quercetin-3-O-galactoside, kaempferol-3-Orutinoside,kaempferol-3-Oglucoside, hydroxyl cinnamic acid derivatives, flavonoid glycosides and flavonoid aglycones from the aqueous extract of fennel fruits [419-420].

Fraxinus ornus

Flavonoids apigenin, quercetin, rutin, quercetin 3-*O*-galactoside and quercetin 3-*O*-glucoside were isolated from the leaves. Rhamnetin, quercetin, rutin, quercetin 3-*O*-galactoside, quercetin 3-*O*-digalactoside and quercetin 3-*O*-rhamnoside were obtained from the flowers. Quercetin, quercetin 3-*O*-rhamnoside and quercetin 3-*O*-galactoside were detected in the bark. Caffeic acid esters were isolated from *Fraxinus ornus* bark[421-424].

Fumaria officinalis

The polyphenols isolated from ethanol extracts of *Fumaria officinalis* were included (mg/g dry weight): flavonols (myricetin: 0.25 ± 0.01, kaempferol 0.08 ± 0.01 and quercetin 0.49 ± 0.03); quercetin glycoside (rutin: 6.47 ± 0.13 and hyperoside: 6.51 ± 0.12); flavanone glycoside (hesperidin: undetected); flavone (apigenin: 0.12 ± 0.02); phenolic acids (*p*-coumaric acid: 1.10 ± 0.03, ferulic acid: 2.35 ± 0.04 and sinapic acid: 0.68 ± 0.02)[425-426].

Fumaria parviflora

The preliminary phytochemical analysis of *Fumaria parviflora* revealed the presence of flavonoids, tannins and phenols[427]. The flavonoids identified in the plant were 3,5,3',4' tetrahydroxy flavone-3-arabinoside; 3'-4'-dihydroxy flavone and 3,7,4'-trihydroxy flavone [428-430]

Galium aparine

Galium aparine seeds contained: 6.36±0.03 % flavinoids and 16.96±0.01% tannins[431]. The total phenolic content in methanol extract of *Galium aparine* was (124.8 µg of Gallic acid equivalent)[432]. The polyphenolic compounds isolated from 70% ethanolic extracts of *Galium aparine* were: caftaric acid: <0.2, gentisic acid: <0.2, gentisic acid : <0.2, caffeic acid: <0.2, chlorogenic acid: <0.2, p-coumaric acid: 1.404 ± 0.28, ferulic acid: 3.793 ± 0.31, hyperoside: 0.300 ± 0.03, isoquercitrin: 0.967 ± 0.13, rutin: 7.983 ± 0.30, quercetin: 5.679 ± 0.26, luteolin: 0.467 ± 0.07 mg /100 g dried vegetal material[433-434].

Galium verum

The total amount of phenolic compounds in the methanolic extract of the aerial parts was (753 ±21 mg/g of extract) and the total flavonoid content was (151.25 ±8.2 mg/g of extract)[435-437]. The dried aerial parts of *Galium verum* contained many phenolics and flavonoids included chlorogenic acid, (+)-catechin, caffeic acid, rutin, coumaric acid, isoquercitrin, quercetin, isorhamnetin, ferulic acid, (–)-epicatechin, hesperidin, fisetin and chrysin[438-442].

Geum urbanum

Geum urbanum aqueous extract contained total phenolic acid 768.2±25.9 mg GAE/l, total flavonoid 14.7±0.9 mg RE/l and proantocyanidins 37.5±1.4 mg CE/l, while ethanol extract contained total phenolic acid 1261.5±31.3 mg GAE/l, total flavonoid 49.9±2.2 mg RE/l and proantocyanidins 60.1±2.1mg CE/l[443-445]. Two flavan-3-ols and three polyphenolic acids were found in leaves, while five flavan-3-ols and two polyphenolic acids in underground organs[446-447].

Glossostemon bruguieri

Preliminary phytochemical analysis of *Glossostemon bruguieri* root showed that it contained flavonoids (1.54 ± 0.05% of dry raw weight) and phenols (13.18 ± 2.3% of dry raw weight)[448-449]. Analysis of moghat root extract revealed the presence of flavonoid apigenin (17.04%)[450]. Biflavone moghatin (3‴-

hydroxycupressuflavone), 4′- methoxyisoscutellargin, was also isolated from the dried peeled roots of *Glossostemon bruguieri*[451-452].

Glycyrrhiza glabra

The total phenolic contents of the ethanolic extract of *Glycyrrhiza glabra* root was 7.47 ± 0.05 mg/ gm of Gallic acid equivalent (GAE), while the total flavonoids contents was 2.25 ± 0.03 µg/gm quercetin equivalents (QE)[453]. Flavonoids isolated from *Glycyrrhiza glabra* included licoflavonol, 5,8-dihydroxy-flavone-7-O-beta-D-glucuronide, glychionide A, 5 – hydroxyl – 8 – methoxyl – flavone – 7 – O – beta – D – glucuronide, glabroisoflavanone A and B and many other compounds [454-457].

Gnaphalium luteoalbum

Flavonoids were isolated from *Gnaphalium luteoalbum* included apigenin; apigenin glucopyranoside; luteolin; luteolin 4'-*O*-*β*-Dglucopyranoside; luteolin 7-*O*-*β*-D-glucopyranoside, Jaceosidin; gnaphalin; 5, 7, 3, 4 tetrahydroxy flavone; 5, 3, 4 trihydroxy flavonol; 3, 5 dihydroxy flavonol; hispidulin-7-O- gluco pyranoside gnaphaliin, calycopterin and 3'- methoxycalycopterin [458-462].

***Gossypium* species:**

Total flavonoid content in the extract was 410 ± 0.74 mg QE/g of dry material. Total phenolic content in *Gossypium herbaceum* was found to be 5.86 ± 0.75 mg GAE/g of dry material[463]. *Gossypium hirsutum* contained flavonoids 11.90±0.4 %, tannins 2.73 mg/100g and total phenol 1.62±0.00 mg/100g[464]. A diglycosylated flavonol was isolated from immature flower buds [465]. Kaempferol, quercetin, and hyperoside flavonoids were also extracted from the ethanol extract of the flowers [466-468].

***Haplophyllum* species**

Haplophyllum tuberculatum contained polyphenols, tannins and flavonoids [469]. Total phenol content was 46.2 mg gallic acid/g in the ethanolic extract of *Haplophyllum tuberculatum* aerial parts[470]. However, Al-Brashdi *et al*., found that the total phenolic content of *Haplophyllum tuberculatum* was 561.22 mg/g of gallic acid equivalent, and flavonoids were 165.54 mg/g of quercetin equivalent[469,471].

Hedera helix

It contained phenolic acids: caffeic, chlorogenic; neochlorogenic; 3,5-O-dicaffeoylquinic; 4,5-O-dicaffeoyl-quinic, rosmarinic; dihydroxybenzoic protocatechuic, *p*-coumaric, and flavonoids: quercetin, kaempferol, rutin, isoquercitrin, astragalin and kaempferol 3-Orutinoside[472-474]. The total phenolic and total flavonoid contents in the leaves extract of *Hedera helix* were: 131.25±1.54 mg GAE/g extract, and 18.61±0.37 mg QE/g extract respectively[472-476].

Helianthus annuus

Quantitative phytochemical analysis of ethanolic leaf extract of *Helianthus annuus* showed that it contained flavonoids 0.03% and phenolic compound 0.34%[477-478]. Eight phenolic compounds: caffeic acid, methyl caffeoate, chlorogenic acid, 4-O-caffeoylquinic acid, 3-Ocaffeoylquinic acid, methyl chlorogenate, 3,5-di-O-caffeoylquinic acid, eriodictyol 5-O-β-d-glucoside cinnamic acid and monoester of quinic acid were isolated from the seed of *Helianthus annuus* [479-480].

Helianthus tuberosus

The total phenol content of the ethanol extract of tubers of *Helianthus tuberosus* was 7.91 mg GAE/g and total flavonoid content was 29.60 ±5.23 mg QE/g[481]. The 70 % ethanol extracts of tubers of different varieties and wild populations of *Helianthus tuberosus*, showed the highest total phenolic content (6-17 mg GAE/g dry weight)[482-483]. Ten chlorogenic acids were identified from the leaves of three *Helianthus tuberosus*[484-486].

Herniaria glabra

Flavonoids isolated from *Herniaria glabra* were included (rutin, isoquercitrin, luteolin, isorhamnetin rhamnose-hexose, hexoside-rhamnoside kaempferol and hydroxyferulic acid derivative), phenolics and others included (3-FQA feruloylquinic acid and quinic acid, 3-*p*-coumaroylquinic acid, 4′-Caffeoylquinic, caffeoylquinic acid, 5′-caffeoylquinic acid, 5′-caffeoylquinic acid, feruloylquinic acid *trans*, 4 FQA tri-feruloylquinic acid *trans*, 4 FQA tri-feruloylquinic acid *cis* and 5 FQA tri-feruloylquinic acid). Quantitative analyzes amounted to 0.69% flavonoids (expressed as isoquercitrin) and 1.02% phenolic acids (expressed as chlorogenic acid)[487-489].

Herniaria hirsuta

Herniaria hirsuta contained phenolics, flavonoids, flavonols and saponins. The total flavonoid content of *Herniaria hirsuta* was 4.51% and the total saponin content was 12.74%[490]. The lyophilized infusion of *Herniaria hirsuta* contained phenols 90±1(mg GAE/g lyophilized infusion), flavonoids 46±3 (mg CE/g lyophilized infusion), esters 38±1(mg CAE/g lyophilized infusion) and flavonols 26±1(mg QE/g lyophilized infusion)[491].

Hibiscus rosa-sinensis

Quantitative phytochemical evaluation of the flowers of *Hibiscus rosasinensis* revealed that the amount of flavonoids was 0.171 mg/g, total phenolics 0.092 mg/g and tannins 0.073 mg/g[492]. The flowers contained flavonoids, rutin, quercetin, kaempferol and myricetin, their contents in methanol extract were 4104.0, 7.6, 361.9 and 50.7 µg/g respectively[493]. Methanol and ethanol extract showed total phenolics 61.45 and 59.31

mg/100g as GAE, total flavonoids 53.28 and 32.25 mg/100g as catechine equivalent, respectively[494]. Crushed red and magenta flower varities yield dark-purplish dye, anthocyanin pigment and cyandin diglucoside, while many flavanoids and cyanidin compounds (quercetin-3-diglucoside, quercetin 3,7- diglucoside, kaempferol-3-xylosyglucoside, cyanidin- 3,5 –diglucoside and cyanidin-3-sophoroside-5-gIucoside) were isolated from other varieties[495-496].

Hibiscus sabdariffa

Analysis of *Hibiscus sabdariffa* petals showed the presence of anthocyanins 16.53 mg/g, phenols 7.40 mg/g and flavonoids 3.50 mg/g (12.76 %)[497]. The phytochemical study of the calyces of *Hibiscus sabdariffa* revealed identification of 10 compounds phenolic acids (protocatechuic acid and chlorogenic acid); flavonoids (eugenol, gossypetin, kaempferol, quercetin, myricetin, luteolin, rutin and astragalin) [498]. Eighteen phenolic compounds were identified *Hibiscus sabdariffa* petals included chlorogenic acid, protocatechuic acid, gossypetrin, sabdaretin, gossypetin, luteolin, gossytrin, hibiscetin, rutin, hibiscetrin, myricetin, eugenol, nicotiflorine, quercitrin, quercetin, kaempferol, astragalin and cyranoside[497, 499].

***Hyoscyamus* species**

The total phenolic, flavonoid and condensed tannins of *Hyoscyamus niger* were 99.45 ± 2.75, 18.23 ± 0.78 and 20.38± 0.69 µg EAG/mg of chloroform leaves extract, while their amounts in the methanol extract were 111 .1 ± 1.82, 24.31 ± 0.62 and 24.87 ± 1.57 µg EAG/mg of extract, and in petroleum ether extract 23.83± 0.21, 6.77± 1.24 and 13.27± 0.69 µg EAG/mg of extract respectively[500-501]. Flavonoids like rutin, spiraeoside, 3',5-dihydroxy-3,4',5',6,7- pentamethoxy flavone; furanoflavonoid glucoside, pongamoside C and flavonol glucoside, pongamoside D were isolated from *Hyoscyamus niger* [502-503]. *Hyoscyamus niger* (leaves) contained chlorogenic acid 0.4±0.0, quercetin-3*O*-glucoside-rhamnoside-rhamnoside (QGRR) 0.4 and rutin 9.2 mg/g dry weight. *Hyoscyamus niger* (epicalyxes) contained chlorogenic acid 1.1, quercetin-3*O*-glucoside-rhamnosiderhamnoside (QGRR) and rutin 3.5 mg/g dry weight[504]. *H. reticulatus* (leaves) contained chlorogenic acid 3.4, quercetin-3-*O*-glucoside- rhamnoside-rhamnoside 19.9 and rutin 8.9 mg/g dry weight. *Hyoscyamus niger* contained chlorogenic acid 1.8, quercetin-3*O*-glucoside-rhamnoside-rhamnoside 2.2 and rutin 0.1mg/g dry weight[505-506].

Hypericum triquetrifolium

Many phenolics were isolated from *Hypericum triquetrifolium* included chlorogenic acid, caffeoylquinic acid, p-coumaroylquinic acid, epicatechin, rutin, hyperoside, I3,II8-biapigenin, isoquercetine, quercitrine, quercetine, quercetin galactoside, quercetin rutinoside, quercetin-3-O-galactoside, kaempferol-3-O-glycoside, apigenin-7-Oglucoside, kaempferol and amentoflavone[507-512]. Chlorogenic acid, rutin, hyperoside, quercitrin, quercetin, and isoquercetin contents (mg/g dry weight) in vegetative stage of wild growing whole plant were 4.45, 2.47, 3.22, 4.52, 0.36, 17.49; in floral budding stage were 6.86, 5.93, 9.32, 7.64, 0.92, 24.65; in full flowering stage were 7.84, 3.61, 15.67, 7.98, 0.64, 7.33; in fresh fruiting stage were 3.48, 1.22, 5.93, 5.68, 0.62, 9.10 and in mature fruiting stage were 0.33, 0.14, 0.37, 0.29, 0.39, 1.38, respectively [513-515].

Inula graveolens

The total phenolic content of the methanolic extract of *Inula graveolens* was 1.63% gallic acid equivalent, while the total flavonoid content was 0.52% quercetin equivalent of dry mass of plant extract[516]. The total phenolic content of the methanolic leaves extracts was 86.19±3.04mg GAE/g extract, and the total flavonoids content was 9.72±0.94 mg QE/g extract[517-519].

Iris pallida

Iris pallida was rich in flavonoids, flavonoids identified in the resinoids of *Iris pallida* rhizomes were included irigenin, iristectorigenin A, nigricin, nigricanin, irisflorentin, iriskumaonin methyl ether, irilone, iriflogenin, 8-hydroxyirigenin, 2,3-dihydroirigenin and benzophenone (2,6,4'-trihydroxy-4-methoxy benzophenone) [520].

Jasminum officinale

The total phenolic contents of the aqueous extract of *Jasminum officinale* leaves was 104.02 ± 1.28 mg/g gallic acid equivalent, the total flavonoids content was 10.76 ± 0.83 mg/g quercetin equivalent and the total flavonols content was 5.65 ± 0.45 mg/g quercetin equivalent[521-522].

Juglans regia

Phenolic compounds were extracted from green walnut fruits, cultivars (Elit) and (Franquette). In ethanolic extract, the total phenolic content ranged from 126.2 mg GAE per g in cultivar Elit to 135.3 mg GAE per g in cultivar Franquette. In methanol extract, more phenolic compounds were extracted in both cultivars respectively (161.07 ± 7.28 and 148.98 ± 4.74mg GAE per g)[523]. Phenolic compounds identified in walnut seeds were included phenolic acids, namely gallic, ellagic, syringic, 5-Ocaffeoylquinic, caffeic, pcoumaric, ferulic and sinapic acids, and tannins, such as glansrins A, B and C, casuarinin and stenophyllarin[524-530].

Juniperus communis

Fifteen phenolic compounds were identified in *Juniperus communis*. The main groups of them were flavones, flavonols, phenolic acids, flavanol and biflavonoid including glycosides of quercetin, apigenin, isoscutellarein and hypolaetin[531]. The total polyphenols of the berries of *Juniperus communis* were 59.17 ± 1.65 mg GAE/g

extract. Flavonoid and biflavonoid content were 25947 and 4346 microg/g extract[532]. Tannins, gallocatechins and flavonoids (scutellarein**,** luteolin-7-O-b-D- glucoside, nicotiflorin, kaempferol-3-O- β-D- glucoside**,** Kaempferol-3-O- a-rhamnopyranoside, Quercetin-3-a-OL- rhamnopyranoside**,** Quercitrin, Isoquercitrin, Quercetin-3-Oarabinosyl- glucoside, rutin, quercetin, luteolin, apigenin, amentoflavone, isocutellarein, hypolaetin, kaempferol 3-O-alpha-rhamnopyranoside, nicotiflorin and naringenin) were isolated from the plant[533-539].

Juniperus oxycedrus

The total flavonoid and flavonol contents of the aerial parts of *Juniperus oxycedrus* were determined using AlCl3 method and their amount calculated as quercetin µEQ/mg. *Juniperus oxycedrus* contained 23.1 and 32.1, µgEQ/mg of total flavonoid and total flavonols respectively[540-541].

Jussiaea repens

Favonoids (quercetin, quercetin 3-O738 rhamnoside or quercitrin, quercetin 3-O -galactoside, quercetin 3-Oglucoside, quercetin 3-O-rutinoside, kaempferol 3-O-glucoside, myricetin 3-O-rhamnosideormyricitrin, andmyricetin 3-O -galactoside, rosmarinic acid, quercetin 3-O-β-D-glucopyranoside and kaempferol 3- O-β-D-glucopyranoside were isolated from the plant[542-548].

Kochia scoparia

A series of flavone glycosides were isolated from fructus kochiae, included quercetin3-O-β-d-apiofuranosyl-(1 → 2)-β-d-galactopyranosyl- 7-O-β-d-glucopyranoside, quercetin 3-O-α-l-rhamnopyranosyl-(1 → 6)- β-d-galactopyranosyl-7-O-β-d-sophoroside, quercetin 7-O-β-dglucopyranoside, quercetin 3-O-β-d-apiofuranosyl-(1 → 2)-β-dgalactopyranoside, quercetin 3-O-β-d-galactopyranosyl-7-O-β-dglucopyranoside, and quercetin 7-O-β-d-sophoroside [549-550].

Lagerstromia indica

The phenolic derivatives isolated from *Lagerstroemia indica* stem were included: stroside A, B and C, hovetrichoside A, hovetrichoside B, (1'*S*,2'*R*)-guaiacyl glycerol, carthamoside B5, (+)-(7*S*,8*S*)-guaiacylglycerol 8-O-*β*-D- glucopyranoside, D-*threo*-guaiacylglycerol 8-*O*-*β*-D-(6'-*O*-galloyl) glycol pyranoside, alatusol A, ficusol, evofolin-B, and marphenol C[551]. The total anthocyanin content of *Lagerstroemia indica* was 36.22 mg/kg[552-555]. The total flavonoids in the 80% ethanolic extract was 27.71mg/g dry weight, and the total phenolics identified was 64.75 mg/g dry weight [556].

Lagerstroemia speciosa

Many phenolics included ellagic acid, epicatechin gallate, quercetin, phenolic glucosides [1-O-benzyl-6-O-E-caffeoyl-β-d-glucopyranoside and 1-O-(7S,8R)-guaiacylglycerol-(6-O-E-caffeoyl)-β-d-glucopyranoside] were isolated from the aerial parts of *Lagerstroemia speciosa* [557-558]. Total phenol, total flavonoid and tannin contents determined in the 40% methanolic extract of dried leaves of *Lagerstroemia speciosa* were 159.93 ± 0.87 of GAE in µg/mg, 9.37 ± 0.73 QE in µg/mg and 80.5 ± 0.19 GAE in µg/mg respectively[559-560].

Lallemantia iberica

Lallemantia iberica produced a many secondary metabolites included phenolic acids, flavonoids and tannins. One polyphenol, rosmarinic acid and six flavonoides: luteolin-7-O-glucoside, 4'-methoxy-luteolin-7-Oglucoside, apigenin-7-O-glucoside, luteolin, diosmetin and apigenin were isolated from the ethyl acetate and methanol extracts of *Lallemantia iberica* aerial parts[561]. A putrescine bisamide phenolic glycoside, N-(trans-feruloyl)-N′-(para-hydroxybenzoyl) putrescine bisamide-4′-O-α-l-rhamnopyranoside and phenolic glycoside, cucurbitoside D, were isolated from the seeds of *Lallemantia iberica*[562-563].

Lallemantia royleana

Total phenolic content of *Lallemantia royleana* was 25.3 mg GAE/g extract[564]. However, the *Lallemantia royleana* seed mucilage total phenolic content was 528.54±0.35µg/ml[565-566].

Lantana camara

Quantitative phytochemical screening of *Lantana camara* showed that the leaves contain flavonoids (11.08±0.05 mg/g) and tannins (9.0±0.03 mg/g)[567]. Polyphenol content of *Lantana camara* was 917.60mg/100g in the leaves and 328.56mg/100g in the stem, while flavonoids content was 3.29mg/100g in the leaves and 8.03 mg/100g in the stem[568-569].

Lathyrus sativus

Lathyrus sativus seeds contained flavonoids, phenols and tannins. Condensed tannin levels in *Lathyrus sativus* ranged from 0 to 4.38 g/kg. The total phenolics ranged from 39 to 999 mg/kg. Both condensed tannins and total phenolics were highly correlated with the seed coat pigmentation. Coloured genotypes containing greater levels of tannin[570]. The phenolic compounds were extracted from 30 varieties of *Lathyrus sativus* into 80% methanol. Total phenolic contents ranged from 1.88 to 7.12 mg/g extract and 20.3 to 70.3 mg/100 g seeds. Two derivatives of p-coumaric acid were the dominant phenolic compounds[571-572].

Lawsonia inermis

Polyphenols (equivalent to gallic acid), tannins (equivalent to catechin), flavonoids (equivalent to quercetin) and anthocyanins (equivalent to cyanindin) in the ethyl acetate extract were: 129.6 ± 4.1, 477.9 ± 12.9, 85.6 ±

3.1 and 0.75 ± 0.02; in petroleum ether extract were: 71.7, 315.6, 52.9 and 1.98; in ethanol extract were: 105.8, 58.1, 33.8 and 5.48 and in decoction were: 100.2, 31.3, 16.2 and 1.86 respectively[573]. Apigenin, luteolin and their derivatives, kampferol, quercetin, isoscutellarin, tricin, kaempferin, isoquercitrin and (-)-catechin were isolated from *Lawsonia inermis* [579-580].

Lemna minor

The total phenolics in the the lyophilized water extract was 22.0 ±0.8 µg/mg extract and the total flavonoids was 16.7 ±0.0 µg/mg extract, while, the total phenolics in the ethanol extract was 4.5 ±0.2 µg/mg extract and total flavonoids was 17.4 ± 0.1 µg/mg extract[581-582].

Leontice leontopetalum

The total phenolic and flavonoid contents of the crude methanol and water extracts of the tubers of *Leontice leontopetalum* L. subsp. *ewersmannii* were 77.13 ± 3.05 and 12.23 ± 0.04 µg PEs/mg extract, and 94.41 ± 1.76 and 13.02 ± 0.17 µg QEs/mg extract, respectively[583]. Isorhamnetin-3-rutinoside (narcissin) and quercetin-3-glucoside were isolated from the leaves and stems of *Leontice leontopetalum*[584-585].

Lepidium sativum

Lepidium sativum ethanolic extract contained total phenolics 4.46±0.14 to 11.03 ± 0.75 (mg GAE/g dw plant material) and a flavonoids of 3.57±1.2 to 4.79 ± 0.24 (mg QE/100 g dw plant material). Phenolics identified in the ethanolic extract of *Lepidium sativum* were kaempferol, coumaroylquinic acid, *p*-coumaroyl glycolic acid and caffeic acid[586-587]. The isoflavonoids: 5,6-dimethoxy-2',3'-methylenedioxy-7-C-β-d-gluco-pyranosyl isoflavone, 7-hydroxy-4',5,6-trimethoxy isoflavone and 7-hydroxy-5,6-dimethoxy-2',3'-methylenedioxy isoflavone were isolated from *Lepidium sativum*[588-589].

Cymbalaria muralis

Various flavonoids were isolated from the ethanolic extract of *Cymbalaria muralis*, included apigenin, luteolin, and chrysoeriol 7-glucosides and 7-glucuronides[590].

Linum usitatissimum

The total phenolic content in the methanolic and butanolic extracts of the seeds of *Linum usitatissimum* were (47.01 and 43.33 µg GAE/g of extract, respectively). The total phenolics content of flax seed meal on a wet weight basis ranged from 130 to 220 mg/100 g. The total phenolics ranged from 162 to 362 mg/100 g in seeds of 5 different flax cultivars. The total flavonoids in the methanolic and butanolic of the seeds of *Linum usitatissimum* were (30.89 and 29.55 µg QE/g of extract), respectively [591-595].

Lippia nodiflora

The methanolic extract of the aerial parts of *Lippia nodiflora* contained phenolic compounds (98.31 mg GAE/g), total flavonoids (60.88 mg QE/g), flavonols (27.46 mg QE/g), total tannin 5.97 mg TAE/g[596]. Nodifloretin, 6-hydroxyluteolin-7-*O*-apioside, luteolin-7-*O*-glucoside, eupafolin, hispidulin-7-sulfate, hispidulin-7,4'-disulfate, jaceosidin-7,4'-disulfate, nepetin-3',4'-disulfate, nodifloretin-6,7-disulfate, 6-hydroxyluteolin-6,7-disulfate, nodifloretin-7-sulfate, 6-hydroxy-luteolin-6-sulfate, 6-hydroxyluteolin-7-sulfate, jaceosidin-7-sulfate, nepetin-7-sulfate, hispidulin-4'-sulfate, hispidulin, jaceosidin, lippiacian, demethoxycentaureidin, ganzalitosin I, 3,7,4',5'-tetrahydroxy-3'- methoxyflavone, 4'-hydroxywogonin, onopordin, cirsiliol, larycitrin and 5,7,8,4'-tetrahydroxy-3'- methoxyflavone were isolated from *Lippia nodiflora*][597-605].

Lithospermum officinale

The shoots of *Lithospermum officinale* contained: rutin 0.754 ± 0.303 mg/g dry matter, hydrocaffeic acid 0.215 ± 0.017 mg/g dry matter, rosmarinic acid 1.2 ± 0.1 mg/g dry matter, and chlorogenic acid 1.032 ± 0.06 mg/g dry matter; while the roots contained: hydrocaffeic acid 0.131 ± 0.015 mg/g dry matter and rosmarinic acid 1.8 ± 0.31 mg/g dry matter[606-608].

Luffa acutangula

The plant contained tannin (1.84 mg /kg), phenol (0.62 mg/kg) and flavonoid (0.45 mg/kg)[609-6011]. Total phenolic content of extract varied between 3.85 ± 0.003 to 30.11 ± 0.005 mg/g GAE. The highest total phenolic content was recorded in ethanol extract 30.11 ± 0.005 mg GAE, while the least in petroleum ether extract 3.85 ± 0.003 mg GAE. The total flavonoid content varied between 5.07 ± 0.001 to 86.50 ± 0.074 mg /g QE of dry extract. The highest flavonoid content was observed in ethyl acetate extract 86.50 ± 0.074, while the least was observed in petroleum ether extract 5.07 ± 0.001 mg /g QE[612-614].

Luffa cylindrica

The total phenol content in various extracts of pulp and peel of the plant was in the range of 0.94-14 mg GAE/g. The plant contained 20.74 mg/g as a total phenolics, 17.94 mg/g as a total flavonoids, 0.5 mg/g as a total anthocyanins, and 1.2 mg/g as an ascorbic acid[615-616]. Many polyphenolic compounds included: p-coumaric acid; 1-O-feruloyl-β-d-glucose; 1-O-p-coumaroyl-β-d-glucose; 1-O-caffeoyl-β-d-glucose; 1-O-(4-hydroxybenzoyl) glucose; diosmetin-7-O-β-d-glucuronide methyl ester; apigenin-7-O-β-d-glucuronide methyl ester; and luteolin-7-O-β-d-glucuronide methyl ester were isolated as hydrophilic antioxidant constituents from

the fruits of *Luffa cylindrica*. The total amount of the eight compounds in the dried gourds without skin was about 1%[617-619].

Lycium barbarum

Total phenolics content of the methanol, acetone, ethanol 50%, ethanol 80% and hydrochloric acid 2% of the fresh goji fruits were 132.02±0.54, 9.28±0.08, 169.71±0.85, 174.27±0.67 and 141.96 ±0.52 gallic acid equivalents/ 100g respectively, while, their amounts in the dried goji fruits were 259.54±0.57, 18.25±0.09, 333.64±0.72, 342.59±0.73 and 414.1 ±0.59 gallic acid equivalents/ 100g respectively[620-623].

Lycopus europaeus

Lycopus europaeus contained tannic acid, luteolin-7-glucoside (23 mg/g), rosmarinic acid (76 mg/g), apigenin-7-monoglucoside, lithospermic acid, ferulic-acid, caffeic acid, chlorogenic acid and ellagic acid[624-626].

Lythrum salicaria

Flavonoids (isoorientin, orientin, isovitexin, vitexin, rutin, luteolin, apigenin), anthocyanins (cyanidin-3-galactoside, malvidin-3,5-diglucoside), phenolics (gallic acid, methyl-gallate, chlorogenic acid, ellagic acid, vanoleic acid dilactone, isochlorogenic acid, caffeic acid, p-coumaric acid, ellagic acid derivatives: (3,3',4'-tri-*O*-methylellagic acid-4-*O*-*β*-D-(2''-acetyl)-glucopyranoside, 3,3',4'-tri-*O*- methylellagic acid-4-*O*-*β*-D-glucopyranoside, 3,3',4'-tri-*O*-methylellagic acid) were isolated from *Lycium ruthenicum*[627-631].

Malva neglecta

The totol phenolics in the methanol extract of *Malva neglecta* (whole plants in flowering stage) was 68.29±0.14 *μ*g pyrocatechol equivalents /mg extract and the total flavonoides was 15.58±0.19 *μ*g quercetin equivalents /mg extract[632-633]. The fruit extract was investigated for phenolic composition. Flavonoid glycosides were the major phenolic compounds. Traces of rutin, chlorogenic acid, hydroxybenzoic acid and hydroxybenzoic acid-*O*-hexoside were also detected in the extract[634-635].

Mangifera indica

The stem bark and leaves contained: phenols 0.75 ± 0.22 and 0.09 ± 0.20, flavonoids 6.86 ± 0.20 and 11.24 ± 0.10 and tannins 1.10 ± 0.20and 0.45 ± 0.10 mg/ 100g. Stem barks contained many phenols, benzoic acid and benzyl ester derivatives (benzoic acid, benzoic acid propyl ester, 3, 4-dihydroxybenzoic acid, gallic acid, gallic acid methyl ester and gallic acid propyl ester); and flavonoids [quercetin, (+) catechin, (-) epicatechin and mangiferin][636-638].

Ononis spinosa

Ononis spinosa contained flavonoids: daidzin, genistin, formononetin 7-O-glucoside (ononin), formononetin**,** formononetin 7-O-glucoside 6"-malonate, biochanin A 7-O-glucoside, biochanin A 7-O-glucoside 6"-malonate (biochanin A), trifolirhizin, onogenin, sativanone, calycosin, pseudobaptigenin, calycosin; pterocarpans (maackiain and medicarpin) and phenolic acids (p-hydroxybenzoic, vanillic acid, caffeic acid, syringic acid, p-coumaric acid, cinnamic acid, sinapin acid, homopipecolic acid, salicylic acid and gentisin acid)[639-645].

Onopordum acanthium

The total phenolic content of the butanolic extract of *Onopordum acanthium* was 8.93 ± 0.133 mg GA/100 mg dry extract and flavonoid content was 3.93± 0.037 mg catechin/100 mg dried extract[646]. The total phenolic contents of ethanolic, methanolic and acetone flower extracts were 19.71, 24.70 and 13.94 mg GAE/l, while, the phenolic contents in the same extracts of the leaves were 26.34, 30.47 and 36.67 mg GAE/l respectively. The total flavonoid contents in the ethanolic, methanolic and acetone flower extracts were 30.37, 42.09 and 32.40 mg QE/l, and the total flavonoid contents in the same extracts of the leaves were 40.06, 53.18 and 85.37 mg QE/l[647-648].

Orchis mascula

The preliminary phytochemical screening showed that the crude extract of *Orchis mascula* contained tannins, phenolics, and flavonoids. Phenolic compounds such as gallic acid, catechin, chlorogenic acid and syringic acid were identified in the plant[649].

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