Proximate Composition and Carbohydrates

The moisture, acid-insoluble ash and crude fiber of the aerial parts of *Aerva javanica*, growing in Egypt are 3.78, 2.56 and 2.24% respectively. The macro and micro elements in the total ash are P, 0.01; K, 1.56; Mg, 0.734; Na, 0.122; Ca, 3.0 %; Fe, 193.2, Mn, 97.35; Zn, 26.55; Cu, 4.2; Cd, 0.125; Li, 1.1 ppm and Pb (traces) (Wassel *et al*., 1997). The proximate composition of *Aerva javanica*, growing in Qatar is as follows: moisture, 5.70; lipids, 1.92; protein, 11.80, fiber, 23.72 and ash, 1.92%. The amino acids of the plant are: arginine, 0.39; histidine, 0.12; isoleucine, 0.31; leucine, 0.57; lysine, 0.36; methionine, 0.10; phenylalanine, 0.36; threonine, 0.33; valine, 0.39; aspartic acid, 0.82; serine, 0.37, glutamic acid, 0.97; proline, 0.88; glycine, 0.46; alanine, 0.41; cystine, 0.10; and tyrosine, 0.29%. The plant contains the following minerals: Na, 0.042; Fe, 0.128; Ni, 0.012; Mn, 0.150; Co, 0.037; Cu, 0.021; Mg, 1.25; Si, 6.52; and Cr, 0.13 ppm (Al-Easa *et al*., 2003). The different elements (Fe, Cd, Cu, Mn, Pb, Cr, Mg, Na, Zn, Ni, Ag, Au, As and Hg) have been determined by others (*e.g*. Rashed, 2010; Hussain *et al*., 2011). Investigation of the carbohydrates (6.12%) of the aerial parts of *Aerva javanica*, growing in Egypt revealed the presence of arabinose, rhamnose, xylose, galactose, glucose, mannose, mannitol (2.2%) and a polysaccharide of pectic nature (3.25%) (Aboutabl *et al*., 1997). Phytochemical screening of the plant revealed the presence of alkaloids, flavonoids, terpenoids and/or steroids (Al-Yahya, 1986; Rizk *et al*., 1986; Ahmed *et al*., 2010).

Lipids

Lauric ($C_{12:0}$, 4.221), myristic ($C_{14:0}$, 0.469), myristoleic (tetradec-9-enoic acid, $C_{14:1}$, 6.431), palmitic ($C_{16:0}$, 5.215), palmitoleic (hexadec-9-enoic acid, $C_{16:1}$, 37.585), stearic

($C_{18:0}$, 7.280), oleic ($C_{18:1}$, 12.882) and linoleic ($C_{18:2}$, 10.105 %) acids were identified in *Aerva javanica* (Abdel-Wahab *et al*., 1997). The study of the fatty acids of *Aerva javanica* var. *bovei* revealed the presence of 14 fatty acids, 11 of which were identified as pelargonic (C_9, nonanoic acid, 0.737), hendecanoic (C_{11}, 1.149), lauric (0.740), myristic (2.343), pentadecanoic (C_{15}, 20.394), stearic (15.775), oleic (8.041), linolenic (4.63), nonadecanoic (C_{19}, 15.655), arachidonic ($C_{20:1}$, 1.490) and eicosatrienoic (19.160 %) acids (Radwan *et al*., 1999). The following fatty acids were identified from *Aerva tomentosa*: myristic, 4.5; palmitic, 71.5; palmitoleic, 2.2; stearic, 10.4; oleic, 1.8; and linoleic, 9.5% (Bishay *et al*., 1977).

Terpenoids, Steroids and Other Lipid Constituents

Patterson *et al*. (1991) identified the following desmethyl sterols from *Aerva javanica* campesterol, stigmasterol, sitosterol, 7-ergostenol, spinasterol, 7-stigmastenol, campestanol, stigmastanol and 22-stigmastenol (Tables 1 and 2). The sterols identified in *Aerva persica* are shown in Tables 1 and 2 (Patterson *et al*., 1991). β-Sitosterol, campesterol, stigmasterol, stigmasterol acetate were isolated from the plant (Usmanghani *et al*., 1982a,b; Abdel-Wahab *et al*., 1997). The following compounds have been identified from both *Aerva javanica* and *Aerva lanata*, growing in Egypt: campesterol, stigmasterol, β-sitosterol, α-amyrin, β-amyrin, lupeol, oleanolic acid, tridecane, tetradecane, pentadecane, hexadecane, heptadecane, octadecane, nonadecane, eicosane, heneicosane, decasone, teracosane, hexacosane, octacosane, nonacosane, triacontane and dotriacontane (Abdel-Wahab *et al*., 1997), betulinic acid and phytol (El-Seedi and Sobaih, 1999). Oleanolic acid, hentriacontane, nonacosane, nonacosanol, tritriacontane, tetratriacontane, campesterol, sitosterol and β-sitosterol glucoside (Usmanghani *et al*. (1982a,b) and ursolic acid (Khan *et al*., 2012) were isolated from *Aerva javanica* growing in Pakistan. Investigation of *Aerva javanica* var. *bovi* Webb, growing in Egypt revealed the presence of α-amyrin, β-amyrin, campesterol, β-sitosterol, a fatty alcohol fraction, ranging from C_{26} - C_{36} (hexacosanol, octacosanol, tricontanol, dotricontanol, and hexatricontanol) and a series of hydrocarbons, ranging from C_{13} to C_{30} *viz*. tridecane, tetradecane, hexadecane, octadecane, nonadecane, eicosane, heneicosane, docosane, tricosane, tetracosane, pentacosane, hexacosane, octacosane and triacontane (Radwan *et al*., 1999).

Three glycosides (sitosterol, lupeol and oleanolic glycosides) (Abdel-Wahab *et al*., 1997) and hentriacontane (Chandra and Sastry, 1990) were identified in *Aerva javanica*. β-Sitosterol and α-amyrin were identified from *Aerva tomentosa* (Bishay *et al*., 1977). Ecdysteroids (0.035%) were isolated from the roots of *Aerva tomentosa* (Maher *et al*., 1995).

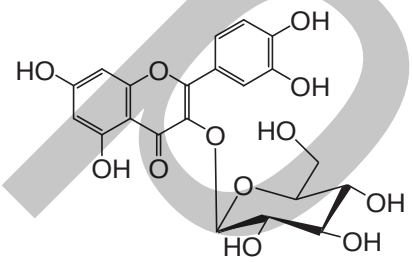
β-Sitosterol, β-sitosteroyl acetate, β-Sitosterol-3-*O*-β-glucopyranoside, lupeol and lupeol acetate were identified from *Aerva persica* (Ahmed *et al*., 2008; Imran *et al*., 2009b).

Flavonoids and Other Phenolics

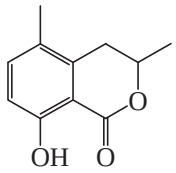
The following flavonoids have been identified from *Aerva javanica*: kaempferol 3-galactoside, kaempferol 3-rhamnogalactoside (Aiyar *et al*., 1973), isorhamnetin 3-*O*-β-[4'''-*p*-coumaroyl-α-rhamnosyl(1→6)galactoside], along with its unacylated derivative, its kaempferol analogue and various kaempferol, quercetin, and isorhamnetin glycosides (Saleh *et al*., 1990), quercetin, quercetin 3-*O*-rutinoside, quercetin 3-*O*-xylosyl(1→2)rhamnoside (El-Seedi and Sobaih, 1999), chrysoeriol, isorhamnetin 3-*O*-rutinoside, kaempferol 3-*O*-robinoside, isoquercetrin (**53**), apigenin 7-*O*-glucuronide and kaempferol 3-*O*-β-D-glucopyranosyl (1→2)-α-L-rhamnopyranoside-7-*O*-α-L-rhamnopyranoside (Aiyar *et al*., 1973; Saleh *et al*., 1990; El-Seedi and Sobaih, 1999; Aboutabl, 1999; Radwan *et al*., 1999; Sharif *et al*., 2011).

5-Methylmellein (**54**), 2-hydroxy-3-*O*-β-primeveroside naphthalene-1,4-dione (**55**) and 7-(1'-hydroxymethyl)-2-(2''-hydroxyethyl)-3,4-dihydrobenzopyran (**56**) (Sharif *et al*., 2011), 3-hydroxy-4-methoxybenzaldehyde and (*E*)-*N*-(4-hydroxy-3-methoxyphenethyl)-3-(4-hydroxy-3-ethoxyphenyl) acryl amide (Khan *et al*., 2012) were also isolated from *Aerva javanica*.

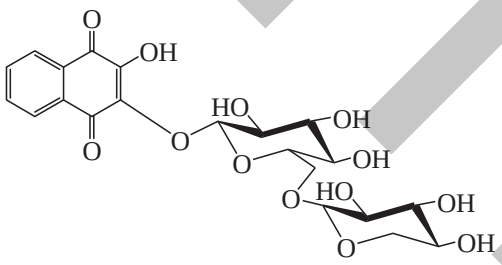
The following flavonoids were isolated from *Aerva persica* Burm. f.: aervanone (8-*C*-β-D-galactosyl-7,4'-dihydroxyflavanone) (Garg *et al*., 1980), persinol (**57**), persinoside A (**58**), persinoside B (**59**), liquiritigenin (**60**), eriodictyol 5-*O*-β-D-glucoside (**61**) (Ahmed *et al*., 2006), 5,4'-hydroxy-3,6,7-trimethoxyflavone, 5-hydroxy-3,6,7,4'-tetramethoxyflavone, apigenin 7-*O*-β-D-glucoside, 5-hydroxy-2',3,5',6,7-pentamethoxyflavone, 3,3',5-trihydroxy-4'-methoxy-flavone-7-*O*-β-glucoside (Ahmed *et al*., 2008), and 5-hydroxy-3',4',6,7,8-pentamethoxyflavone (Imran *et al*., 2009b). Chrysin 7-*O*-galactoside was isolated from the roots of *Aerva persica* (Garg *et al*., 1979).



53 Isoquercetrin



54 5-Methylmellein



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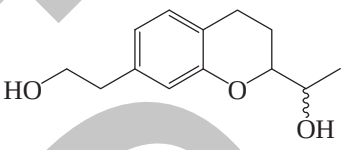

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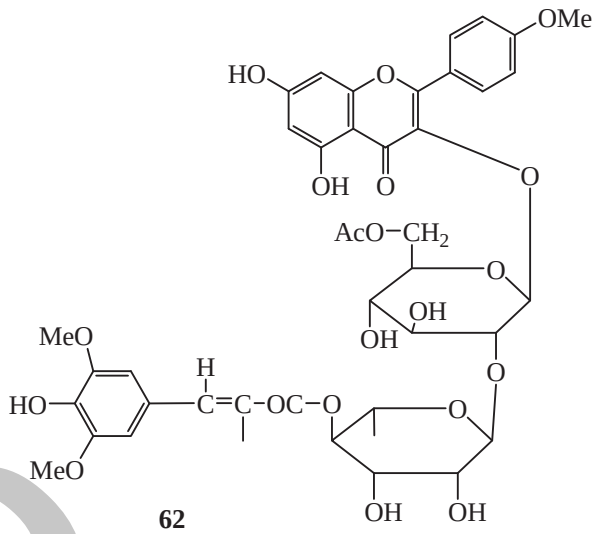
	R	R_1	R_2	R_3	R_4
57 Persinol	-Me	-OH	-H	-OH	-OH
58 Persinoside A	-Me	-OH	-β-D-glu	-H	-OH
59 Persinoside B	-β-D-glu	-OH	-H	-OH	-OH
60 Liqiritegnin	-H	-H	-H	-H	-H
61 Eriodictyol 5-glu	-H	-H	-H	-OH	-β-D-glu

Bishay *et al*. (1977) reported the isolation of four kaempferol glycosides from *Aerva tomentosa* Forssk. (*Aerva persica* Burm. f.), growing in Egypt. From the perianth lobes of *Aerva tomentosa*, a rare flavonol glycoside, kaempferide 3-*O*-(6''-*O*-acetyl-4'''-*O*-α-methylsinapyl) neohesperidoside (**62**) has been isolated (Jaswant *et al*., 2003).



62

The following compounds have been isolated from *Aerva persica*: methylgravillate, benzoic acid (Ahmed *et al*., 2008), aervins A-D (coumaronochromone analogues) (Imran *et al*., 2009a), 4-hydroxybenzaldehyde, 4-hydroxybenzoic acid, 5,7-dimethoxycoumarin, 5,8-dihydroxycoumarin, 5,6,7-trimethoxycoumarin, 4-hydroxy-3,5-dimethoxybenzaldehyde, 3,4'-dihydroxy-3',5'-dimethoxypropiophenone and gallic acid (Imran *et al*., 2009b).

Saponins and Alkaloids

Three glycosides (β-sitosterol glucoside and two saponin glycosides) were isolated from *Aerva javanica* growing in Egypt. Hydrolysis of saponin glycoside I yielded lupeol, galactose and glucose. Saponin II gave on hydrolysis oleanolic acid, galactose, glucose and rhamnose (Abdel-Wahab *et al*., 1997).

Ammar *et al*. (1996) isolated two alkaloids, aervin (10-hydroxy-canthin-6-one) and methyl aervin (10-methoxy-canthin-6-one) from *Aerva javanica* growing in Egypt.

Folk Medicine, Pharmacological and Biological Activities

Different uses in folk medicine have been attributed to both *Aerva javanica* and *Aerva lanata*, being mainly used as diuretic and in kidney troubles (Chopra *et al*., 1956; Lewis and Elvin-Lewis, 1977; Aboutabl *et al*., 1997; Punjani, 2010). Both species are also useful in strangury (Punjani, 2010).

Aerva javanica has been used by Egyptian Bedouins, as an analgesic, local anesthetic, antitoxic (or snake bite) and antihistaminic (El-Seedi and Sobaih, 1999). *Aerva javanica* var. *bovi* is diuretic and demulcent, and is effective in lithiasis. It is also used as anti-inflammatory, for headache and toothache. *Aerva javanica* var. *javanica* is used as anthelmintic, diuretic, demulcent, against rheumatism and for the treatment of headache (Qureshi and Bhatti, 2009).

Aerva persica posesses diuretic and demulcent properties (Garg *et al*., 1979); the roots and flowers are reported to posess medicinal properties against rheumatism and kidney troubles (Garg *et al*., 1980). In Pakistan, the roots are used in headache and as demulcent. Decoction of the roots is given as tonic to pregnant women. It is also used for the treatment of dysentery, gonorrhea, kidney disorders and cutaneous infections (Ahmed *et al*., 2008).

Aerva javanica extracts showed antimicrobial (antibacterial and antifungal) activity (Mufti *et al*., 2012). The antibacterial activity of the ethyl acetate extract and fatty acids of *Aerva javanica* var. *bovei* was reported (Radwan *et al*., 1999). The aqueous extract of *Aerva*