

Scrutinising special qualities of phytochemicals

Studied in detail in this article are qualities of isoflavones, phytohormones and phytosterols.

Isoflavones have the phenyl group attached to the 3-position, whereas in flavones the phenyl group is attached to the 2-position. Isoflavones mainly occur within the Leguminosae (specifically in the sub-family Papilionoideae), although the literature shows many other species that contain these chemical moieties [Boland and Donnelly]. Isoflavones are also found in other botanical families such as the Compositae, the Iridaceae, the Myristicaceae, and the Rosaceae.

These isoflavones can act as steroidal mimics by filling the stereochemical space that could be occupied by oestrogenic compounds. It is this spatial chemistry that helps explain the effects of many nutritional herbal supplements and topical preparations.

Daidzein (Fig. 1) is a phytoestrogen, but is also called a phenolic estrogen, to distinguish it from a steroidal estrogen like 17 β -estradiol (Fig. 2). The activity of the phytoestrogen is much weaker than the steroidal estrogen, varying from 0.005-2% [Brand]. The estrogenic properties are insufficient in strength to replace steroidal

Figure 1: Estrogen receptor with daidzen.

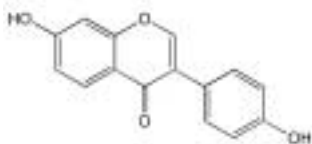
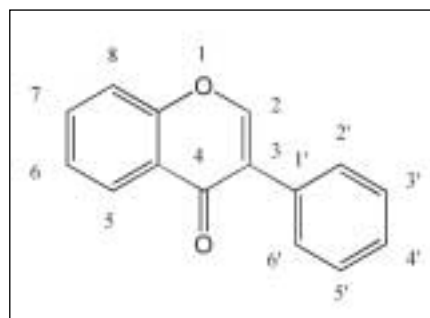
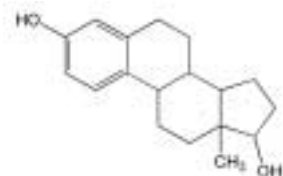


Figure 2: Estrogen receptor with 17 β -estradiol.



Numbering protocol for isoflavones.

estrogens, but they do have significant value when it comes to reducing the effects of ageing and improving the quality of the skin.

Phytoestrogens may also be viewed in relation to the phytochemical division of terpenoids, which comprise the largest group of natural plant products. All terpenoids are derived biogenetically from isoprene. The largest group of terpenoids are the triterpenoids, which include, amongst other divisions, the triterpenoid and steroid saponins, and the phytosterols. The phytoestrogens fall into these three categories.

Figure 3: Stigmasterol.

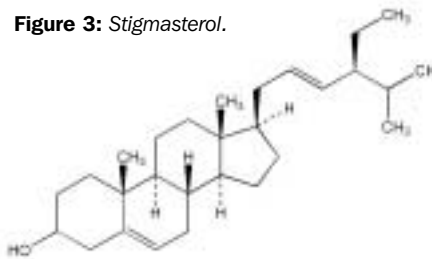
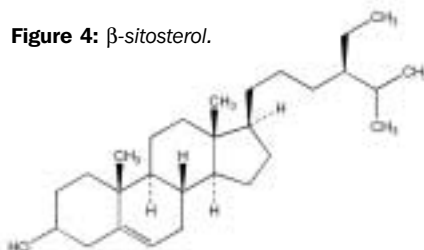


Figure 4: β -sitosterol.



In addition, nature has a rich portfolio of phytosterols. It is easy to understand why sterols like stigmasterol (Fig. 3) and β -sitosterol (Fig. 4) have an effect that is anti-inflammatory and capable of reducing swelling and erythema, when their structure is compared to corticosterone (Fig. 5) and hydrocortisone (Fig. 6).

The article concludes with a look at phytohormones and compares them to synthetic hormones and explains their effects against this known background.

Isoflavones

The most commonly occurring isoflavones are:

Biochanin-A	5,7-dihydroxy-4'-methoxyisoflavone
Daidzein	4',7-dihydroxyisoflavone
(+/-)-Equol	4',7-isoflavandiol
Formononetin	7-hydroxy-4'-methoxyisoflavone
Glycitein	4',7-dihydroxy-6-methoxyisoflavone
Genistein	4',5,7-trihydroxyisoflavone
Genistein-4',7-dimethylether	5-hydroxy-4',7-dimethoxyisoflavone
Prunetin	4',5-dihydroxy-7-methoxyisoflavone

with the associated glucosides:

Genistin	glucosyl-7-genistein
Glycitin	4',7-dihydroxy-6-methoxyisoflavone-7-d-glucoside
Ononin	formononetin-7-O-glucoside
Sissotrin	biochanin A-7-glucoside

Figure 5: Corticosterone.

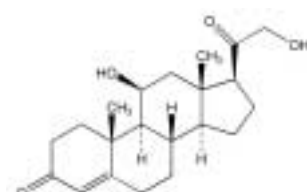


Figure 6: Hydrocortisone.

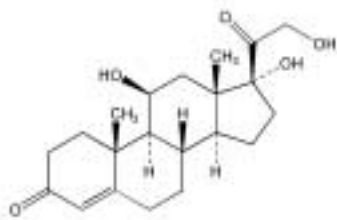


Figure 7: Malonyldaidzin.

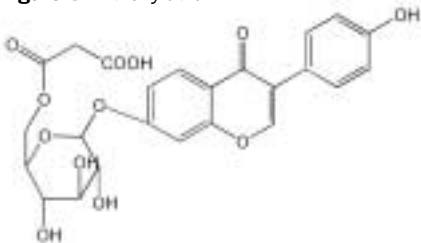


Figure 8: Acetyldaidzin.

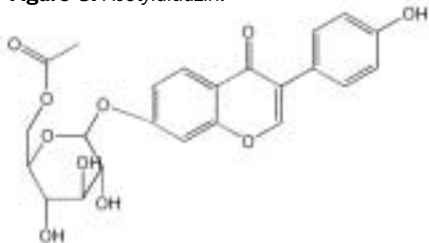


Figure 9: Kwakhurin, kwakhurin hydrate.

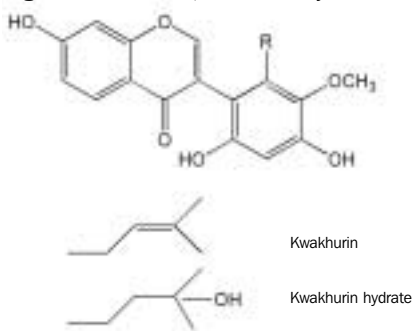


Figure 10: Puerarin.

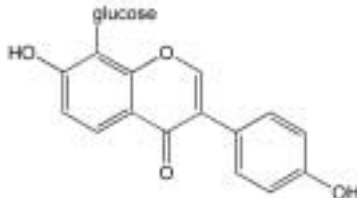


Figure 11: Mirificoumestan.

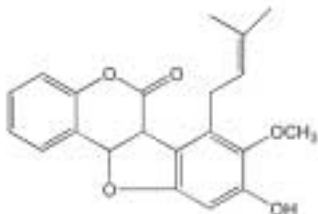


Figure 12: Deoxymiroestrol.

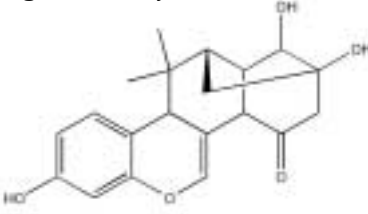
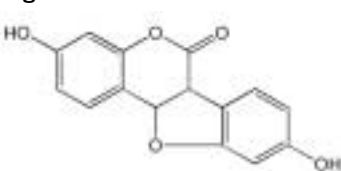


Figure 13: Coumestrol.



traditional uses. Also looked for are those effects that are typically hormonal e.g. effects on hormonal-dependent organs like breasts and the reproductive system (male and female). At the same time, steroidal materials by reputation are anti-inflammatory, anti-oedema and anti-erythema in their action.

Kudzu Vine (*Pueraria labata*)

The roots of *Pueraria labata* are used for a herbal medicine commonly known as the Kudzu Vine. It has been used for centuries in traditional Chinese medicine for the treatment of alcohol abuse and is thought to be effective because of the daidzein and daidzin found in the herb. A study on Syrian Golden Hamsters showed suppression of desire for alcohol [Keung et al].

White Kwao Krua (*Pueraria mirifica*)

In addition to genistein, daidzein, daidzin and genistin, the plant contains some unique isoflavones, kwakhurin, kwakhurin hydrate (Fig. 9) and puerarin (Fig. 10) to name but a few [Dweck, 2003].

The roots also contain mirificoumestan (Fig. 11), deoxymiroestrol (Fig. 12) and coumestrol (Fig. 13). The traditional use of the plant is clearly for the hormonal properties, since in Thailand it is used for breast development. When *Pueraria mirifica* is taken as a dietary supplement, its phytoestrogen constituents will naturally alleviate symptoms occurring as a result of the ageing process and a deficiency in estrogen levels, e.g. sagging breasts, wrinkled skin, bone loss, grey hair, etc. These ageing signs and symptoms will, to a certain extent, be reversed.

The rich source of sterols and phytohormones also indicates the plant for the topical treatment of wrinkles and ageing skin conditions.

Plants that contain coumestrol: *Brassica oleracea* var. *gemmifera* var. *gemmifera* DC [Brassicaceae] shoot 400 ppm, *Pisum sativum* L. [Fabaceae] fruit 300 ppm, *Medicago sativa* subsp. *sativa* [Fabaceae] shoot 190 ppm, *Pisum sativum* L. [Fabaceae] seed 0.6 ppm, *Glycine max* (L.) MERR. [Fabaceae] seed, shoot, leaf, plant, root, *Medicago sativa* subsp. *sativa* [Fabaceae] leaf, plant, sprout seedling, root, leaf, root, seed, *Phaseolus vulgaris* subsp. var. *vulgaris* [Fabaceae] fruit, leaf, sprout seedling, *Psoralea corylifolia* L. [Fabaceae] root, *Pueraria montana* subsp. var. *lobata* (WILLD.) MAESEN & S. M. ALMEIDA [Fabaceae] stem, root, *Spinacia oleracea* L. [Chenopodiaceae] leaf, *Taraxacum officinale* WEBER EX F. H. WIGG. [Asteraceae] plant, *Trifolium pratense* L. [Fabaceae] flower, leaf, shoot, *Vicia faba* L. [Fabaceae] seed, *Vigna radiata* (L.) WILCZEK [Fabaceae] seed, sprout seedling, *Vigna unguiculata* subsp. *unguiculata* [Fabaceae] seed, stem.

A more detailed list of isoflavones is shown in Appendix I [Boland and Donnelly]. The comparison of effects and functions of plants containing the same isoflavones shows remarkable similarity.

Daidzein as an example of an isoflavone

Daidzein is a solid substance that is virtually insoluble in water. Its molecular formula is C₁₅H₁₀O₄, and its molecular weight is 254.24 daltons. Daidzein is also known as 7-hydroxy-3-(4-hydroxyphenyl)-4H-1-benzopyran-4-one and 4',7-dihydroxyisoflavone. Daidzin, which has greater water solubility than daidzein, is the 7-beta glucoside of daidzein.

Daidzein is an isoflavone. It is also classified as a phytoestrogen since it is a plant-derived nonsteroidal compound that has estrogen-like biological activity. Daidzein is the aglycone (sometimes called the aglucon) of daidzin (see Fig. 1).

The isoflavone is found naturally as the glycoside daidzin and as the glycosides 6"-O-malonyldaidzin (Fig. 7) and 6"-O-acetyldaidzin (Fig. 8). Daidzein and its glycosides are mainly found in the Leguminosae family that includes soya beans and chickpeas.

Soya beans and other soya foods are the major dietary sources of these substances. Daidzein glycosides are the second most abundant isoflavones in soya beans and other soya foods; genistein glycosides are the most abundant.

Non-fermented soya foods, such as tofu, contain daidzein, principally in its glycoside forms. Fermented soya foods, such as tempeh and miso, contain significant levels of the aglycone.

Plants and their effects

Examined here are a number of plants that contain similar actives to ascertain whether there are any similarities between their

Figure 14: Biochanin A.

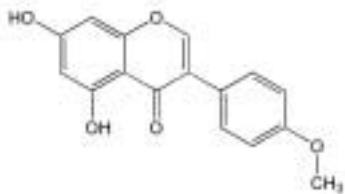


Figure 15: Formononetin.

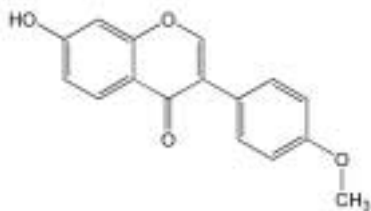


Figure 16: Genistein.

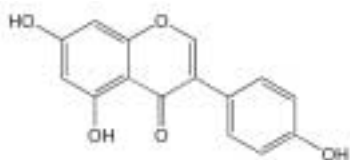


Figure 17: Equol.

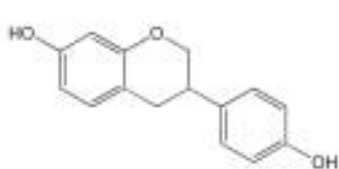
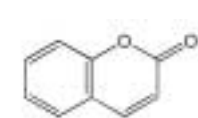


Figure 18: Coumarin.



Red Clover (*Trifolium pratense*)

The flowerheads are used and they contain the isoflavones; biochanin A, daidzein, formononetin, genistein, pratensein, and trifoside. The plant has alterative, antispasmodic, expectorant properties and is a sedative dermatological agent. Its main use is an alterative and for skin complaints such as psoriasis and eczema, as well as an expectorant use in coughs and bronchial conditions [Wren].

Biochanin A (Fig. 14) and formononetin (Fig. 15) are two isoflavones from Red Clover and are just like genistein and daidzein, except that they have methyl groups replacing the hydroxyl groups.

Other sources of biochanin A are *Baptisia tinctoria* (Wild Indigo), *Medicago sativa* (Alfalfa), *Sophora japonica*

(Japanese Pagoda Tree) and *Vigna radiata* (Mungbean).

These two isoflavones are considerably less estrogenic in their original forms, because the stereochemistry of the methoxy groups means they are not able to bind to the estrogen receptors as efficiently.

However, once these molecules are ingested, bacteria in the colon are able to remove the methyl groups – biochanin A becomes genistein (Fig. 16) and formononetin becomes daidzein (Fig. 1). Daidzein can be further metabolised to equol (Fig. 17).

Other sources of formononetin are *Astragalus membranaceus* (Astragalus), *Cimicifuga racemosa* (Black Cohosh), *Glycyrrhiza glabra* (Licorice root), *Medicago sativa* (Alfalfa), *Pueraria* spp. (Kudzu; Pueraria) and *Vigna radiata* (Mungbean).

Internally, biochanin A and formononetin are then able to be a source of considerable estrogenic activity.

Other sources of genistein are *Baptisia tinctoria* (Wild Indigo), *Cytisus scoparius* (Scotch Broom), *Glycine max* (Soya bean), *Glycyrrhiza glabra* (Licorice root), *Medicago sativa* (Alfalfa), *Pueraria* spp. (Kudzu; Pueraria), *Sophora japonica* (Japanese Pagoda Tree) and *Vigna radiata* (Mungbean).

It may well be that these mechanisms give Red Clover its reputation as an alterative remedy, cleansing the system yet mild enough for many children's skin problems, even eczema. A lotion of Red Clover can be used externally to give relief from itching in skin disorders. Specific for acne, boils and similar eruptions, including eczema and skin problems especially where irritation is a factor [Evans].

Historically, the flower tea has been used as an antispasmodic, expectorant and mild sedative. It is also recommended for athlete's foot, sores, burns, and ulcers. [Leung & Foster] and has been used in the herbal treatment of cancer, especially of the breast or ovaries [Mills].

Red Clover is also a very popular remedy as the alternative for hormone replacement therapy and is sold extensively for this purpose.

Sweet Yellow Melilot (*Melilotus officinalis*)

Melilot is soothing, lenitive, astringent, refreshing and anti-irritant and has similar properties to the Red Clover described previously. It is also described as possibly having the additional properties of being anti-inflammatory, anti-oedema, a venous astringent (haemorrhoids) and anaesthetic [Council of Europe].

However, it is perhaps not the isoflavones at force here, but maybe the β -sitosterol or coumarin the roots contain.

Melilotus officinalis L. extract, containing 0.25% coumarin (Fig. 18) was



Red Clover (*Trifolium pratense*).

studied on acute inflammation induced with oil of turpentine in male rabbits. *M. officinalis* had anti-inflammatory effects because it reduced the activation of circulating phagocytes and lowered citrulline production.

These properties were similar to those of hydrocortisone sodium hemisuccinate and coumarin. [Plesca-Manea et al].

Black Cohosh (*Cimicifuga racemosa*)

Clinical experience has shown this drug to be a useful remedy in the treatment of chorea. It has also been employed, though with less certainty of benefit, in chronic rheumatism, urticaria, neuralgia, and dysmenorrhea. It is also asserted to act as a specific in tinnitus aurium [Wood and Remington].

A two-phase study combining a clinical trial and animal experiments was carried out at the University of Göttingen, in order to establish whether *Cimicifuga* extracts can reduce gonadotropin secretion in menopausal women and in ovariectomised rats.

It was found that *Cimicifuga racemosa* extracts contain three lipophilic compounds which selectively influenced gonadotropin LH levels and bound to the oestrogen receptors. An oestrogenic effect has been demonstrated in both clinical and animal studies, providing evidence that the extracts provide an alternative treatment for symptoms associated with the menopause, and in particular for hot flushes. [Duker and Kopanski].

In women treated for eight weeks with the commercial product Remifemin (an alcoholic extract of *C. racemosa*) luteinising hormone levels were reduced significantly. This product is used for the management of menopausal hot flushes [Lawrence].

Figure 19: Avenasterol.

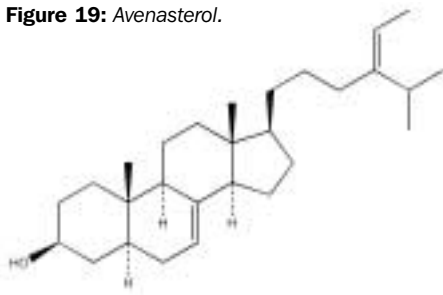


Figure 22: Pregnanolone.

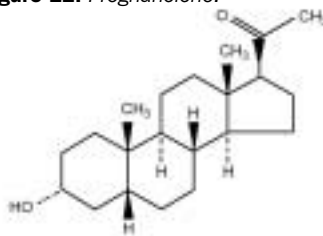


Figure 20: Avenanthramides.

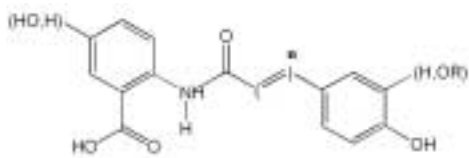


Figure 23: Progesterone.

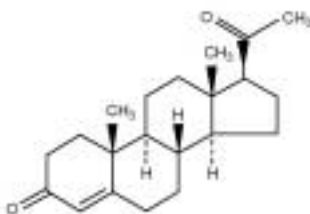


Figure 21: Diosgenin.

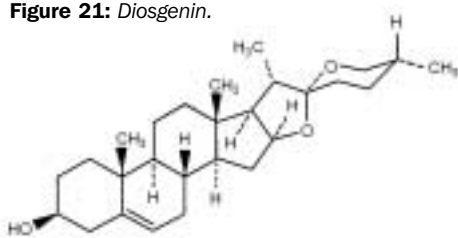
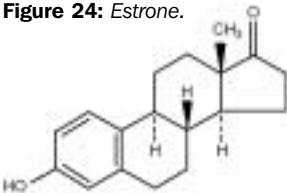


Figure 24: Estrone.



The Wild Yam (*Dioscorea villosa*).

In other sources Black Cohosh is said to be used mainly to treat rheumatism and to relieve muscular and neurological pain. It is recommended in the treatment of female diseases, and is claimed to relieve painful menstruation and uterine cramps and can also be used in cases of delayed menstruation. Black Cohosh is also used in homoeopathic medicine mainly for the treatment of female ailments and menopausal problems. [Tlalaj & Czechowicz]. It has no reported topical use except for the treatment of snake bite by the American Indians and so was also called Black Snake Root [Grieve].

Phytosterols and related compounds

A UK committee on toxicity of chemicals in food, consumer products and the environment formed a working group to examine phytoestrogens – studied were cellular and molecular mechanisms of phytoestrogen activity.

The work was conducted at the Department of Biochemical Pharmacology, Imperial College School of Medicine, London, and prepared for discussion was a paper titled "Assessment of the estrogenic potency of phyto-compounds". This reviewed the available information on cellular and molecular mechanisms and phytoestrogen estrogenic potencies. Out of the 28 points (really statements for comment) the following stood out:

Taking all estrogen receptor binding assays into account the review proposed the following rank order of phytoestrogen potency: estradiol >> coumestrol > 8-prenylaringenin > equol >= genistein > biochanin A > daidzein > genistein glucuronide* > daidzein glucuronide* > formononetin (the activity of those compounds marked * may be due to the presence of activating enzymes present in the receptor preparation).

Phytoestrogens stimulated *in vitro* cell proliferation at concentrations of 0.1–10 mM (3–4-fold less than estradiol). They did not induce the maximal proliferative effect of estradiol as higher concentrations inhibited proliferation.

The majority of endogenous estrogens (> 90%) were not freely available but bound to plasma proteins. Phytoestrogens bound at 1/100th to 1/1000th the affinity of estradiol. The availability of phytoestrogens in plasma relative to estradiol will be greater.

Coumestrol, 8-prenylaringenin and equol were > 1000-fold less potent than estradiol and the isoflavones > 10000-fold less potent.

It is well known that oats (*Avena sativa*) have a beneficial effect on the skin. It may be that the avenasterol (Fig. 19) has a beneficial effect or it could also be the avenanthramides (Fig. 20) that have an anti-irritant anti-allergic effect. A colloidal fraction extracted from avena has been

used in the preparation of emollient dermatological preparations [Martindale; Wren].

Externally, fine oatmeal makes an excellent poultice and may be applied to the skin as a cleansing rub. Also the oatmeal can be placed in cotton bags and rubbed over the skin as a complexion treatment. The bags when squeezed out will produce a milky lotion [Levy]. The straw is used in external preparations in baths, sitz-baths for haemorrhoids and footbaths [Mindell]. Oats are good for sores, inflammations and rough skin. They help to soften the skin (to draw out splinters and foreign bodies). The literature is agreed that they make an exceptional healing poultice for the skin and will lessen the pain in an infected wound. Oats are indicated for chapped hands and for healing skin eruptions, as well as to reduce the itching in eczema [Buchman; Bunney; Genders; Hoffman].

Oatmeal and oatmeal fractions are used for improving the skin. Prepared from native oats, oat oil is effectively a concentrated form of one of oatmeal's major active agents, which has been demonstrated to moisturise. Its ability to emulsify large quantities of water in oil makes it a powerful vehicle for hydrating and moisturising epidermal layers [Dull].

Native oats contain up to 9% lipids, with the highest concentrations found within the germ (24.6% lipids). However,

the germ represents a small proportion of the total groat mass; thus it is of a limited value as a source of the oil. The endosperm, on the other hand, contains 85% of the total edible groat's lipid fraction. Therefore the oil is extracted from the entire groat rather than from any particular portion.

Plants and their effects

The Wild Yam (*Dioscorea villosa*)

The Wild Yam (*Dioscorea villosa*) was the source of diosgenin (Fig. 21), a steroidal saponin used as the starting point for the commercial source of pregnanolone (Fig. 22) and progesterone (Fig. 23) used as the first birth control pills. The root of *Dioscorea* is used for numerous purposes, but the major use is for the suppression of menopausal symptoms such as hot flushes [Watson].

There are many other sources of diosgenin:

Trigonella foenum-graecum L. [Fabaceae] seed 3300-19000 ppm, *Solanum nigrum* L. [Solanaceae] fruit 4000-12000 ppm, *Daucus carota* L. [Apiaceae] root 5400-6000 ppm, *Dioscorea bulbifera* L. [Dioscoreaceae] tuber 4500-4500 ppm, *Medicago sativa* subsp. *sativa* [Fabaceae] seed, *Agave sisalana* PERRINE [Agavaceae] plant, *Aletris farinosa* L. [Liliaceae] root, *Areca catechu* L. [Arecaceae] seed, *Asparagus officinalis* L. [Liliaceae] shoot, *Balanites aegyptiacus* (L.) DELILE [Balanitaceae] fruit, *Chamaelirium luteum* (L.) A. GRAY [Liliaceae] root, *Costus speciosus* (J. KONIG) SM. [Costaceae] rhizome, *Dioscorea composita* HEMSL. [Dioscoreaceae] plant, *Dioscorea* sp. [Dioscoreaceae] root, *Dioscorea villosa* L. plant, *Dioscorea villosa* L. [Dioscoreaceae] tuber, *Jateorhiza palmata* MIERS [Menispermaceae] root, *Lycium chinense* MILL. [Solanaceae] flower, *Melilotus officinalis* LAM. [Fabaceae] seed, *Momordica charantia* L. [Cucurbitaceae] fruit, *Paris polyphylla* SM. [Liliaceae] rhizome, *Smilax china* L. [Smilacaceae] root, *Solanum dulcamara* L. [Solanaceae] plant, *Tribulus terrestris* L. [Zygophyllaceae] shoot. [Phytochemical and Ethnobotanical Databases]

During pregnancy, small frequent doses will help allay nausea [Lust; Grieve]. It is antispasmodic, and is valuable for neuralgic affections, spasmodic hiccough and spasmodic asthma [Grieve].

Furthermore, it is spasmolytic, and a mild diaphoretic and has potential in skin care and body care being anti-inflammatory and anti-rheumatic.

It is also cited for dysmenorrhoea, ovarian and uterine pain [British Herbal Pharmacopoeia; Hoffman], perhaps showing the power of this herbal root.

Vitex agnus-castus is a source of natural progesterone. Proprietary

Figure 25: Prasterone or Dehydroepiandrosterone (DHEA).

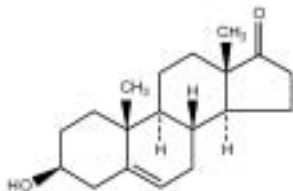


Figure 26: Sarsapogenin.

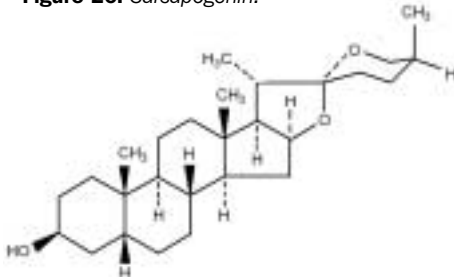
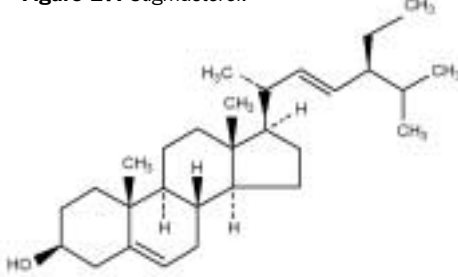


Figure 27: Stigmasterol.



preparations containing this material have been available in Germany since the 1950s and many documented studies have investigated the use of these products to treat various gynaecological disorders [Newall]. The fruit of *Vitex* contains essential oils, iridoid glycosides, and flavonoids. Essential oils include limonene, 1,8 cineole, and sabinene 3. The primary flavonoids include castican, orientin, and isovitexin. The two iridoidglycosides isolated are agnuside and aucubin. Agnuside serves as a reference material for quality control in the manufacture of *Vitex* extracts. One other report demonstrated delta-3-ketosteroids in the flowers and leaves of *Vitex* that probably contained progesterone and 17-hydroxyprogesterone [Brown]. The active constituents have been determined as 17- α -hydroxyprogesterone (leaf), 17-hydroxyprogesterone (leaf), androstenedione (leaf), δ -3-ketosteroids (leaf), epitestosterone (flower), progesterone (leaf), testosterone (flower and leaf) [Phytochemical and Ethnobotanical Databases].

It is highly unlikely that the diosgenin in the plant could ever be synthesised on the topical application to the skin to form a corticosteroid or hormonal derivative. However, it does seem likely that this material (being the precursor to these

estrogenic molecules) will to some extent mimic the function of those pharmaceutical active materials and benefit the skin [Dweck, 2002].

However, the production of wild yam was unable to sustain the demand for diosgenin as the starting precursor, for the production of birth control materials, which by this stage was dominated by estrone (Fig. 24).

Fenugreek

(*Trigonella foenum graecum*)

The world turned its attention to Fenugreek (*Trigonella foenum graecum*) for its source of diosgenin.

Fenugreek or Foenugreek seeds are emollient and accelerate the healing of suppurations and inflammations. Externally cooked with water into a porridge and used as hot compresses on boils and abscesses in a similar manner to the usage of linseed [Fluck].

Decoctions of whole plant are used as a bath for uterus infections. The seeds are tonic, restorative, aphrodisiac and galactagogue. Their emollient properties are useful to calm itching. A cataplasm obtained by boiling the flour of the seeds with vinegar and saltpetre is used for swelling of the spleen [Boulos]. Extracts of the seeds are incorporated into several cosmetics claimed to have effect on premature hair loss, and as a skin cleanser [Iwu], and it is also reported in Java in hair tonics and to cure baldness [Leung]. Many of the herbal materials found to have an effect on hair growth have a hormonal or hormonal-mimetic basis.

Likewise, there are a number of references to Fenugreek having galactagogue (increase milk in nursing mothers) activity [Bunney; Burkill; Mills], which again is indicative of an estrogen-like activity. The plant should be used with caution as Fenugreek is reputed to be oxytocic and *in vitro* uterine stimulant activity has been documented [Newall *et al*], so the use of Fenugreek during pregnancy and lactation in doses greatly exceeding those normally encountered in foods is not advisable.

Pomegranate (*Punica granatum*)

Pomegranate is one of the many plants that contain substances with hormone-type action. The seeds of pomegranate, that ancient symbol of fertility, were found to contain an estrone identical with the genuine hormone. *Punica granatum* seeds are the best source of plant estrone to date [Weiss]. The scientific data on pomegranate is not prolific, but is it a coincidence that the plant has been a symbol of fertility?

The antioxidant and eicosanoid enzyme inhibition properties of pomegranate (*Punica granatum*) fermented juice and

Figure 28: β -ecdysterone.

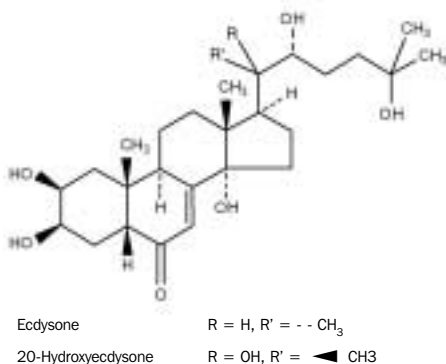


Figure 29: β -sitosterol.

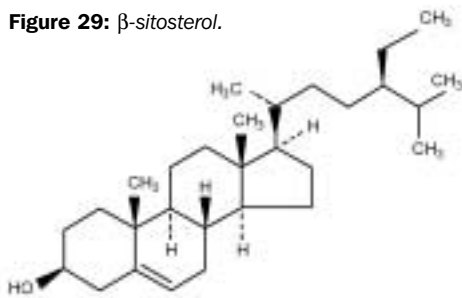


Figure 30: Estradiol.

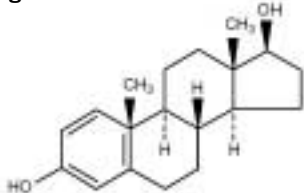
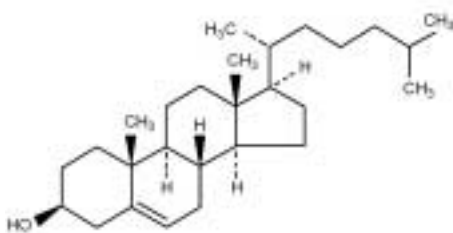


Figure 31: Cholesterol.



seed oil flavonoids were studied, which showed strong antioxidant activity (determined by measuring the coupled oxidation of carotene and linoleic acid) close to that of butylated hydroxyanisole (BHA) and green tea, and significantly greater than that of red wine. [Schubert *et al*].

This is clearly a fruit worthy of further exploration, especially as most of the information to date relates to the use of the bark, seeds and the roots as a taenicide (expelling worms). The rind is used as an astringent [Lust]. The leaf has antibacterial properties and is applied externally to sores [Stuart].

Duke's database [Phytochemical and

Ethnobotanical Databases] shows the following plants as containing estrone: *Punica granatum* L. Pomegranate (seed) 17 ppm, *Malus domestica* BORKH. apple (seed), *Zea mays* L. corn (seed oil), *Humulus lupulus* L. hops (fruit), *Olea europaea* L. olive (seed), *Panax quinquefolius* L. American Ginseng (plant), *Phaseolus vulgaris* L. Anasazi Bean (flower), *Phoenix dactylifera* L. – date palm (seed), *Prunus armeniaca* L. – apricot (seed).

Date Palm (*Phoenix dactylifera*)

Body hormones play a central role in skin appearance and are implicated in skin ageing. Studies have shown that the decrease of these hormones plays an important role in skin endogenous ageing, reduced skin thickness, and the disturbance of normal collagen turnover which, in turn, results in a decrease in collagen I and III synthesis. Date Palm has seven compounds with regenerative, anti-oxidising, firming, and soothing properties, extracted from the kernel: phytosterols, phytosteroids, ursolic acid, isoflavons, policosonols, pro-vitamin A and vitamin E.

Some studies suggest that DHEA (Fig. 25) administration would have a beneficial effect against signs of ageing. DHEA is known for its capacity to promote keratinisation of the epidermis or to reinforce the barrier function of the skin.

The author compared, on *ex vivo* skin, the effects of Date Palm kernel extract with those of DHEA in reference to DHEA as an anti-ageing molecule. There was a decrease of wrinkles within only five weeks of Date Palm kernel extract application and also improvement of the skin structure in a way superior to that of DHEA [Dal Farra].

The seed and the pollen have both been shown to contain estrone and this may further explain the reasons for this activity [Morton; Duke].

Sarsaparilla (*Smilax ornata*)

Also called Honduras Sarsaparilla or Red Sarsaparilla, Spanish Sarspirilla. The root tea has been used externally for skin problems, scrofula, ringworm and tetter [Lust].

It may well be the steroidal saponins present in Sarsaparilla that contribute to its benefits. However, in addition to saponins, sarsaponin and parallin, which yield isomeric sapogenins, sarsapogenin and smilagenin, it also contains sitosterol and stigmasterol in the free form and as glucosides. [British Herbal Pharmacopoeia, 1982]. A rarely seen ϵ -sitosterol has also been reported [Bradley].

Sarsaparilla is stated to possess antirheumatic, antiseptic, and antipruritic



Date Palm (*Phoenix dactylifera*).

properties. Traditionally it has been used for psoriasis and other cutaneous conditions, chronic rheumatism, rheumatoid arthritis, as an adjunct to other treatments for leprosy, and specifically for psoriasis [Newall *et al*], especially for psoriasis where there is desquamation [British Herbal Pharmacopoeia, 1983]. Several related *Smilax* species native to China are used to treat various skin disorders. *Smilax china* or China Root is used as the alternative to Sarsaparilla.

Interestingly, two isomeric genins are known: smilagenin and sarsapogenin (Fig. 26), which are used in the partial synthesis of cortisone and other steroids [Evans]. It has been shown that Sarsaparilla contains chemicals with properties that assist testosterone activity in the body [Hoffmann]. In Central and South America, various strains of Sarsaparilla have been used medicinally for centuries as a general tonic, a remedy for impotence and a cure for sexual diseases [Watson]. It is used also in concoctions with other plants as a tonic or aphrodisiac [Seaforth]. The use of the plant for treating gonorrhoea [Honychurch; Leung], and syphilis [Carrington; Grieve] is widely reported.

Plants with a future for topical application

In view of the benefits seen with those plants containing genistein and daidzein, examined were other plants that might have potential as topical materials, and the possibility of them containing phytosterols and/or phytohormones was investigated. The results were promising.

Figure 32: Campesterol.

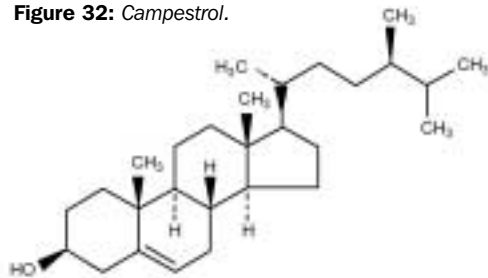


Figure 33: Ergosterol.

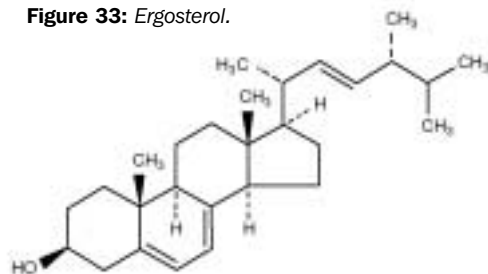


Figure 34: Fucosterol.

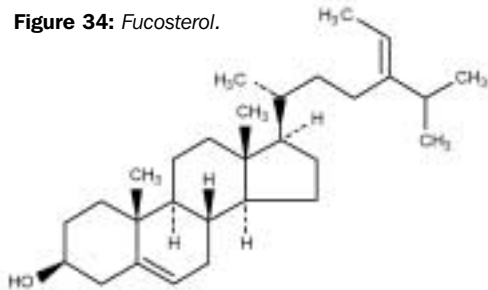
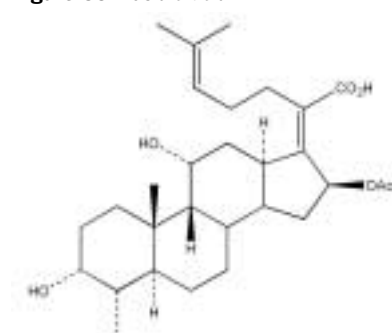


Figure 35: Fusidic acid.



Calabar Bean (*Physostigma venenosum*)

Other plants that contain stigmasterol (Fig. 27) (the main contenders): *Annona cherimola* MILL. [Annonaceae] seed 3080-4000 ppm, *Panax quinquefolius* L. [Araliaceae] plant 500 ppm, *Vigna radiata* (L.) WILCZEK [Fabaceae] seed 230-230 ppm, *Limonia acidissima* L. [Rutaceae] fruit 150-150 ppm, *Limonia acidissima* L. [Rutaceae] leaf 120-120 ppm, *Fagopyrum esculentum* MOENCH. [Polygonaceae] seed 92 ppm, *Centella asiatica* (L.) URBAN [Apiaceae] plant 40 ppm, *Medicago sativa* subsp. *sativa* [Fabaceae] fruit 40 ppm, *Salvia officinalis* L. [Lamiaceae] leaf 5 ppm. [Phytochemical and Ethnobotanical Databases].

Suma or Brazilian Ginseng (*Pfaffia paniculata*)

Other plants that contains β -ecdysterone (Fig. 28): *Morus alba* L. [Moraceae] leaf, *Chenopodium album* L. [Chenopodiaceae] root. Ecdysterone: *Achyranthes aspera* BLUME [Amaranthaceae] shoot, *Achyranthes bidentata* BLUME [Amaranthaceae] root, *Morus alba* L. [Moraceae] leaf, *Paris quadrifolia* L. [Liliaceae] plant, *Polypodium aureum* L. [Polypodiaceae] rhizome, *Taxus baccata* L. [Taxaceae] leaf. [Phytochemical and Ethnobotanical Databases].

Cherimoya (*Annona cherimoya*)

Major plants that contain β -sitosterol (Fig. 29): *Annona cherimola* MILL. [Annonaceae] seed 10000-14000 ppm, *Crataegus laevigata* (POIR.) DC [Rosaceae] flower 6500-7800 ppm, *Crataegus laevigata* (POIR.) DC [Rosaceae] leaf 5100-6200 ppm, *Nigella sativa* L. [Ranunculaceae] seed 3218-3218 ppm, *Oenothera biennis* L. [Onagraceae] seed 1186-2528 ppm, *Salvia officinalis* L. [Lamiaceae] leaf 5-2450 ppm, *Morus alba* L. [Moraceae] leaf 2000 ppm, *Senna obtusifolia* (L.) H. IRWIN & BARNEBY [Fabaceae] seed 1000-2000 ppm, *Fagopyrum esculentum* MOENCH. [Polygonaceae] seed 1880 ppm, *Ocimum basilicum* L. [Lamiaceae] leaf 896-1705 ppm, *Zea mays* L. [Poaceae] Silk Stigma Style 1300 ppm, *Salvia officinalis* L. [Lamiaceae] stem 1214 ppm, *Ocimum basilicum* L. [Lamiaceae] flower 1051 ppm, *Syzygium aromaticum* (L.) MERR. & L. M. PERRY [Myrtaceae] essential oil 1000 ppm, *Hippophae rhamnoides* L. [Elaeagnaceae] seed 550-970 ppm, *Glycine max* (L.) MERR. [Fabaceae] seed 900 ppm, *Nepeta cataria* L. [Lamiaceae] shoot 900 ppm, *Glycyrrhiza glabra* L. [Fabaceae] root 500 ppm, *Ocimum basilicum* L. [Lamiaceae] root 408 ppm, *Viola odorata* L. [Violaceae] plant 330 ppm, *Cnicus benedictus* L. [Asteraceae] seed 243 ppm, *Ocimum basilicum* L. [Lamiaceae] sprout seedling 230 ppm, *Withania somnifera* (L.) DUNAL [Solanaceae] root 200 ppm, *Serenoa repens* (W. BARTRAM) SMALL [Arecaceae] fruit 189 ppm, *Turnera diffusa* WILLD. EX SCHULT. [Turneraceae] shoot 33 ppm, *Agrimonia eupatoria* L. [Rosaceae] shoot 25 ppm, *Medicago sativa* subsp. *sativa* [Fabaceae] fruit 5 ppm. [Phytochemical and Ethnobotanical Databases].

Lima Bean or Butter Bean (*Phaseolus lunatus*)

Other plants that contains estradiol (Fig. 30): *Humulus lupulus* L. [Cannabaceae] fruit, *Panax ginseng* C. A. MEYER [Araliaceae] root, *Panax quinquefolius* L. [Araliaceae] plant, *Punica granatum* L. [Punicaceae] seed.

[Phytochemical and Ethnobotanical Databases].

Conclusion

It has been shown that many of the activities of the herbs shown can be explained (in part) by the steroidal or steroid-mimetic content of the plant. The major sterol found in man is cholesterol (Fig. 31), which acts as the precursor to other steroid structures such as the sex hormones and corticosteroids [Dewick].

Surprisingly it is also found in *Phoenix dactylifera* or Date Palm as well as in certain red algae (Rhodophyceae) [Moreau].

The plant sterols like campesterol (Fig. 32) and sitosterol (Fig. 4) are analogues of cholesterol.

These sterols are extremely well tolerated by the skin and this fact may well explain their ability to reduce swelling, reduce redness and lower inflammation. The ingested effect of these phytosterols and phytohormones has a consistent effect on hormone-related issues, such as breast enlargement and menopausal difficulties. In some cases they have been shown to have influence as aphrodisiacs.

The survey has shown that these materials are significant and do exert a physiological effect.

The fungi have their own sterol the most predominant is called ergosterol [Dewick]. The exploitation of cosmetic raw materials derived from mushrooms and other fungi would appear to be justified.

Another source of beneficial skin care materials have been the brown algae, in particular, the *Fucus* species. In this example is found another sterol, this time called fucosterol (Fig. 34), which was originally isolated from *Fucus vesiculosus* [Merck].

Another fungus – *Acremonium fusidioides* yields a material called fusidic acid, which, interestingly, gives the fungus a narrow-spectrum antibiotic effect that is particularly effective against *Staphylococcus* spp and other Gram +ve bacteria. It is especially useful in the treatment of wound infections

These active plant materials should not be taken in isolation, as they are a part of an orchestra of individual components, each complementing and enhancing the overall effect of the herb.

Space does not permit a review of the significant role of steroidal saponins in this article. PC

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Appendix I

Isoflavone

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2*-Hydroxy-5-methoxy-6,7-methylenedioxy-	<i>Celosia argentia</i> , aerial parts (Amaranthaceae)
2*,5-Dimethoxy-6,7-methylenedioxy-	<i>C. argentia</i> , aerial parts (Amaranthaceae)
6,7,8,3*,4*,5*-Hexamethoxy-	<i>Petalostemon purpureus</i> , bark
7,8,3*,4*,5*-Pentamethoxy-	<i>P. purpureus</i> , bark
Nervosin (5,7,4*-trihydroxy-2*,3*,6*-trimethoxy-)	<i>Garcinia nervosa</i> , leaves (Clusiaceae)
Irigenina (5,7,3*-trihydroxy-6,4*-trimethoxy-)	<i>G. nervosa</i> , leaves
7-Methyltectorigenina (5,4*-dihydroxy-6,7-dimethoxy-)	<i>G. nervosa</i> , leaves
Irisjaponin A (5,7-dihydroxy-6,2*,3*,4*,5*-pentamethoxy-)	<i>Iris japonica</i> , aerial parts (Iridaceae)
Irisjaponin B (5,7-dihydroxy-6,2*,3*,4*-tetramethoxy-)	<i>I. japonica</i> , aerial parts
Nigrinin (4*-hydroxy-5-methoxy-6,7-methylenedioxy-)	<i>I. nigricans</i> , rhizomes (Iridaceae)
Nigrinin (4*-hydroxy-5,3*-dimethoxy-6,7-methylenedioxy-)	<i>I. nigricans</i> , rhizomes
Isocladrastin (3*-hydroxy-6,7,4*-trimethoxy-)	<i>I. kashmiriana</i> , rhizomes (Iridaceae)
Kashmigenin (4*-hydroxy-3*,5*-dimethoxy-6,7-methylenedioxy-)	<i>I. kashmiriana</i> , rhizomes
2*-Methoxyformononetin (7-hydroxy-2*,4*-dimethoxy-)	<i>Eschscholtzia californica</i> , whole plants (Papaveraceae)
2*,4*-Dihydroxy-7-methoxy-	<i>E. californica</i> , whole plants
Gerontoisoflavone A (7,4*-dihydroxy-5,3*-dimethoxy-)	<i>Cudrania cochinchinensis</i> var. <i>gerontogea</i> root wood, (Moraceae)
Aciceroneb (6-hydroxy-7-methoxy-3*,4*-methylenedioxy-)	<i>Astragalus cicer</i> , roots
Erysenegalensein D	<i>Erythrina senegalensein</i> , stem bark
Erysenegalensein E	<i>E. senegalensein</i> , stem bark
Erysenegalensein F	<i>E. senegalensein</i> , stem bark
Erysenegalensein G	<i>E. senegalensein</i> , stem bark
Erysenegalensein H	<i>E. senegalensein</i> , stem bark
Erysenegalensein I	<i>E. senegalensein</i> , stem bark
Erysenegalensein K	<i>E. senegalensein</i> , stem bark
Erysenegalensein L	<i>E. senegalensein</i> , stem bark
Erysenegalensein M	<i>E. senegalensein</i> , stem bark
5-O-Methyl-4*-O-(3-methylbut-2-enyl)	
alpinumisoflavone	<i>Milletia thonningii</i> , root bark
Thonninginisoflavone	<i>M. thonningii</i> , root bark
Durallone	<i>M. dura</i> , seed pods
6-Demethyldurallone	<i>M. dura</i> , seed pods
Predurallone	<i>M. dura</i> , seed pods
Isoerythrinin A 4*-(3-methylbut-2-enyl) ether	<i>M. dura</i> , seed pods
Glyasperin N	<i>Glycyrrhiza aspera</i> , roots
Kanzonol K	<i>G. uralensis</i> , roots
Kanzonol L	<i>G. uralensis</i> , roots
Kanzonol T	<i>G. glabra</i> , roots
Eurycarpin A	<i>G. eurycarpa</i> , roots
Anagyroidisoflavone A	<i>Laburnum anagyroides</i> , pods
Anagyroidisoflavone B	<i>L. anagyroides</i> , pods
Laburnetin	<i>L. anagyroides</i> , pods
Alpinumisoflavonea	<i>L. anagyroides</i> , pods
Secundiflorol B	<i>Sophora secundiflora</i> , roots
Secundiflorol C	<i>S. secundiflora</i> , roots
Isolupalbigenin	<i>Lupinus luteus</i> , roots
Ormosidin	<i>Ormosia monosperma</i> , root bark
Eturnagarone	<i>Derris scandens</i> , stems
Eriosemaone D	<i>Eriosema tuberosum</i> , roots
Ficusin A	<i>Ficus septica</i> , root bark (Moraceae)
Ficusin B	<i>F. septica</i> , root bark
5,3*,4*,2*+ -Tetrahydroxy-2+,2+-dimethylpyrano [5+,6+:7,8]-6-(3*+-methylbut-3*+-enyl-)	<i>Maclura pomifera</i> , fruit (Moraceae)
5-Hydroxy-8-methoxy-3*,4*-methylenedioxy	
6+,6+-dimethylpyrano[2+,3+:7,6]-	<i>Lonchocarpus subglaucescens</i> , roots
6,8-Diprenylgenisteina	<i>Erythrina sigmoidea</i> , root bark
Scandenonea	<i>E. sigmoidea</i> , root bark
Neobavaisoflavonea	<i>E. sigmoidea</i> , root bark
Glycosides	
Prunetin-4*-O-apiosyl(1[6]glucoside (coromandelin)	<i>Dalbergia coromandeliana</i> , leaves (Fabaceae)
Genistein 5-methyl ether 4*-glucoside	<i>Cotoneaster simonsii</i> , leaves (Rosaceae)
2*-Hydroxygenistein 6-C-á-L-rhamnosyl(1[2]glucoside (nodosin)	<i>Cassia nodosa</i> , flowers
2*-Hydroxygenistein 8-C-glucoside	<i>C. siamea</i> , leaves
5,6,6*-Trimethoxy-3*,4*-methylenedioxy	
isoflavone 7-O-(2+-p-coumaroylglucoside)	<i>Trichosanthes anguina</i> , seeds (Cucurbitaceae)

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