Isoflavones, Phytohormones and Phytosterols

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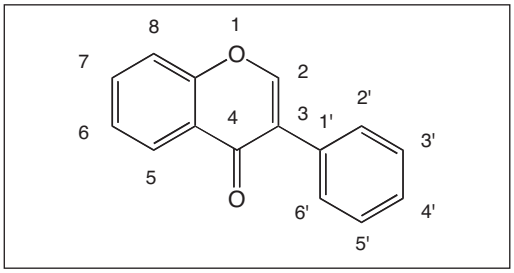
Summary

A review of isoflavones, plant derived hormones and sterols in the care of the skin. The effects have been shown to include protection of the skin, the reduction of wrinkles, reduction in inflammation and a decrease in pruritis. In some commercial raw materials, there has been improvement in breast and skin firmness and reduction in sun burn cell reaction. Internally, these plants are used for reducing the incidence of hot flushes and other discomforts in menopausal women.

Riassunto

Gli isoflavoni, derivati ormonali delle piante, e gli steroli, sono frequentemente utilizzati per la cura della pelle. Di questi composti sono noti gli effetti topici quali sostanze protettive nei confronti degli inquinanti ambientali o quali sostanze attive nel ridurre il numero e la profondità delle rughe o efficaci nel mitigare i processi infiammatori e il prurito.
Dato il loro uso sempre più frequente nei disturbi della menopausa, utilizzati anche per via sistemica, viene descritta e riportata la formulazione chimica, il meccanismo d'azione e i principi attivi contenuti nelle diverse tipologie di estratti vegetali già noti.

INTRODUCTION



Isoflavones have the phenyl group attached to the 3-position, whereas in flavones the phenyl group is attached to the 2-position. The isoflavones are mainly found to 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 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 spacial chemistry that helps explain the effects of many nutritional herbal supplements and topical preparations.

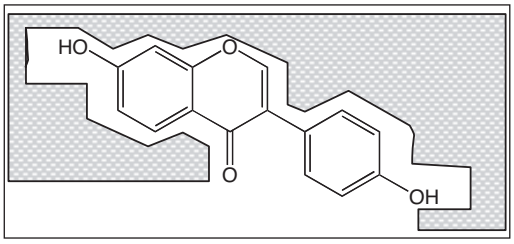


Fig. 1 *Estrogen receptor with daidzen.*

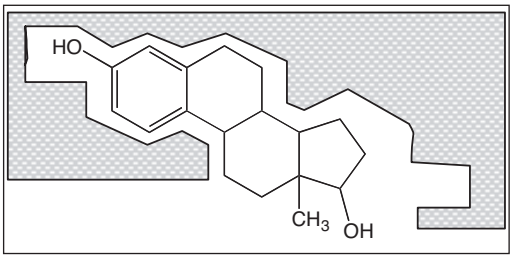


Fig. 2 *Estrogen receptor with 17β-estradiol.*

Daidzein is a phyto-estrogen, but is also called a phenolic estrogen, to distinguish it from a steroidal estrogen like 17β-estradiol. The activity of phytoestrogen is much weaker than the steroidal estrogen, varying from 0.005-2% [Brand]. The estrogenic properties are insufficient in strength to replace steroidal estrogens, but they do have significant value when it comes to reducing the effects of ageing and improving the quality of the skin.

Phyto-oestrogens 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 phyto-oestrogens fall into these three categories. 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).

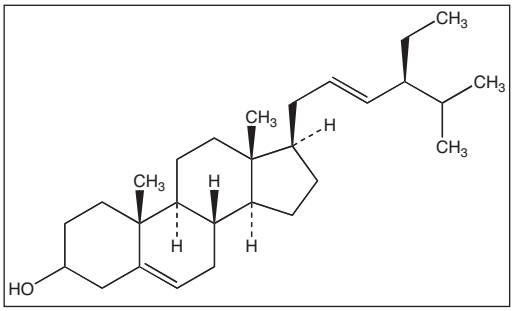


Fig. 3 *Stigmasterol.*

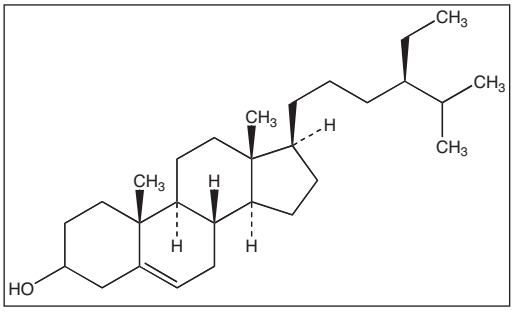


Fig. 4 *β-sitosterol.*

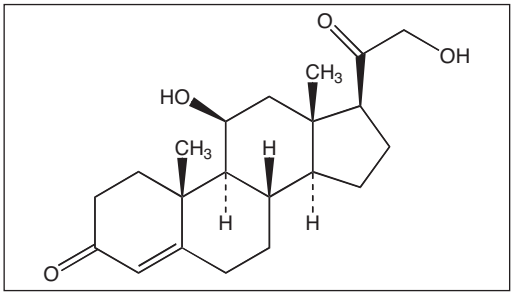


Fig. 5 *Corticosterone.*

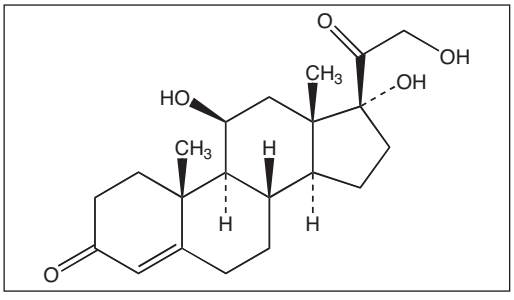


Fig. 6 *Hydrocortisone.*

The paper 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
Formonometin	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

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 $C_{15}H_{10}O_4$, 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 non-steroidal 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.9) and 6"-O-acetyldaidzin (Fig.10). Daidzein and its glycosides are mainly found in the Leguminosae family that includes soy beans and chickpeas.

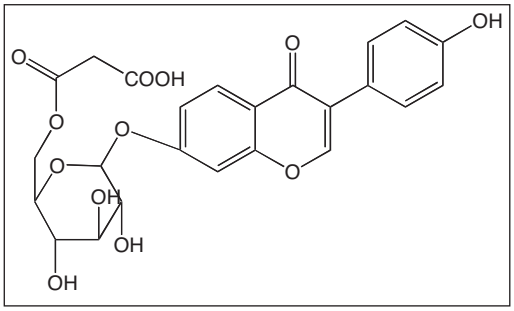


Fig. 9 *Malonyldaidzin.*

Soybeans and soy foods are the major dietary sources of these substances. Daidzein glycosides are the second most abundant isoflavones in soybeans and soy foods; genistein glycosides are the most abundant.
Nonfermented soy foods, such as tofu, contain daidzein, principally in its glycoside forms. Fermented soy foods, such as tempeh and miso, contain significant levels of the aglycone.

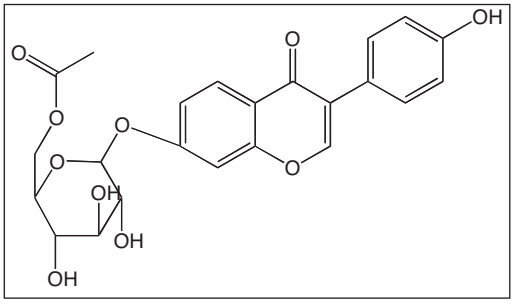


Fig. 10 *Acetyldiadzin.*

Kudzu Vine (Pueraria labata)
The roots of Pueraria labata is an 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 thought to be effective because of the daidzein and daidzin found in the herb. A study on Syrian Golden Hamsters suppressed the alcohol choice [Keung et al].

White Kwao Krua (Pueraria mirifica)

In addition to genistein, daidzein (see above), daidzin and genistin, the plant contains a some unique isoflavones, kwakhurin, kwakhurin hydrate (Fig.11) and puerarin (Fig.12) to name but a few [Dweck, 2003].

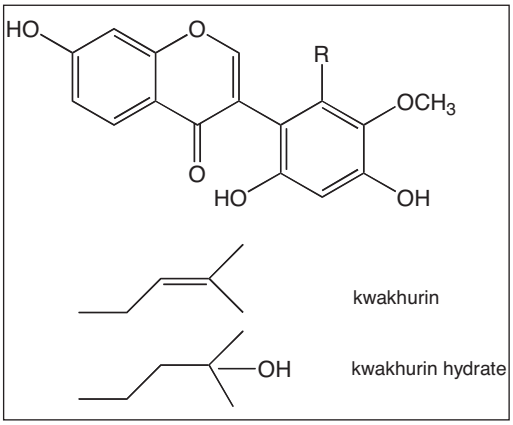


Fig. 11 *kwakhurin, kwakhurin hydrate.*

The roots also contain mirificoumestan (Fig.13), deoxymiroestrol (Fig.14) and coumestrol (Fig.15). 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 aging process and a deficiency in estrogen levels, e.g. sagging breasts, wrinkled

skin, bone loss, grey hair, etc. These aging signs and symptoms will, to a certain extent, be reversed.

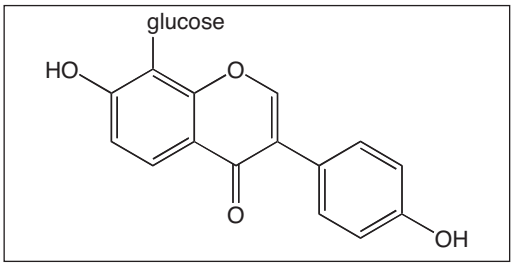


Fig. 12 *puerarin.*

The rich source of sterols and phyto-hormones also indicates the plant for the topical treatment of wrinkles and aging skin conditions.

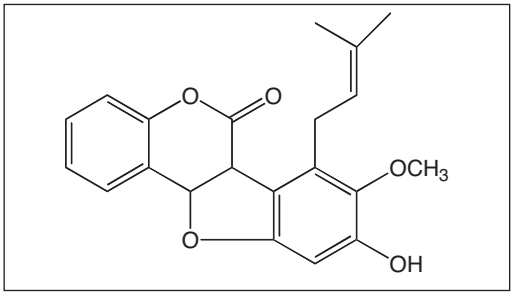


Fig. 13 *mirificoumestan.*

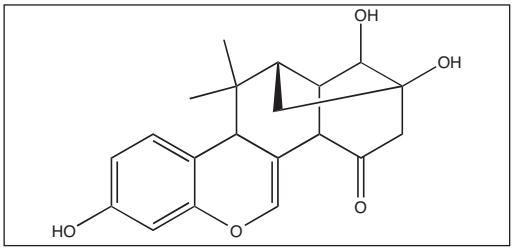


Fig. 14 *deoxymiroestrol.*

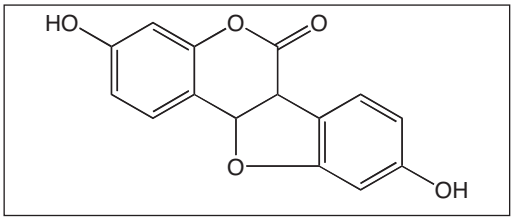


Fig. 15 *coumestrol.*

Plants that contain coumestrol: Brassica oleracea var. gemmifera var. gemmifera DC [Brassicaceae] Shoot 400ppm, Pisum sativum L. [Fabaceae] Fruit 300ppm, Medicago sativa subsp. sativa [Fabaceae] Shoot 190ppm, Pisum sativum L. [Fabaceae] Seed 0.6ppm, 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.

Red Clover (Trifolium pratense L) (Leguminosae).

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.16) and formononetin (Fig.17)are two isoflavones from red clover and are just like genistein and daidzein, except that they have methyl groups replacing
the hydroxyl groups.

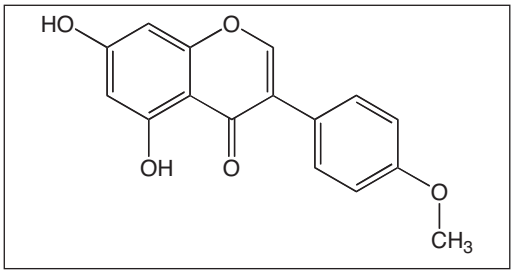


Fig. 16 *Biochanin A.*

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.

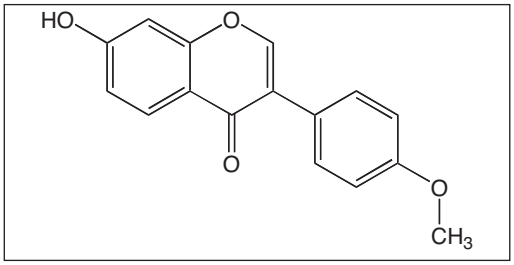


Fig. 17 *Formononetin.*

However, once these molecules are ingested, bacteria in the colon are able to remove the methyl groups - biochanin A becomes genistein (Fig.18) and formononetin becomes daidzein (Fig.1 see above). Daidzein can be further metabolized to equol (Fig.19).

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.

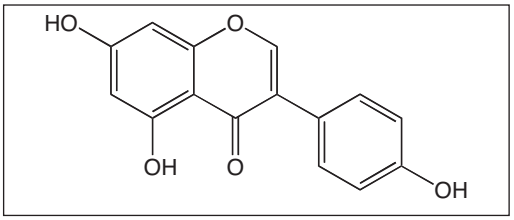


Fig. 18 *Genistein.*

Other sources of genistein are Baptisia tinctoria (Wild Indigo), Cytisus scoparius (Scotch Broom), Glycine max (Soybean), 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].

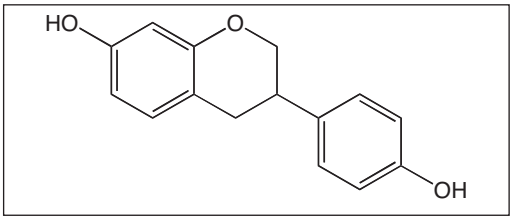


Fig. 19 *Equol.*

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 above. It is also described as possibly having the additional properties of being anti-inflammatory, anti-oedema, a veinous 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 20) was 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.

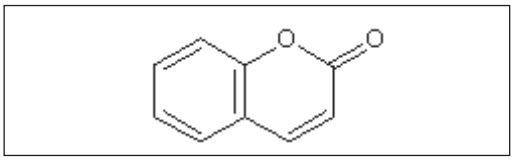


Fig. 20 *coumarin.*

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

PHYTOSTEROLS AND RELATED COMPOUNDS

The benefits of these phytosterols may be seen in the common herbal materials indicated for arthritis, such as Frankincense (Boswellia serrata). The boswellic acid present inhibits two inflammatory enzymes, 5-lipoxygenase (which produces leukotrienes) and human leukocyte elastase HLE (which degades elastase).

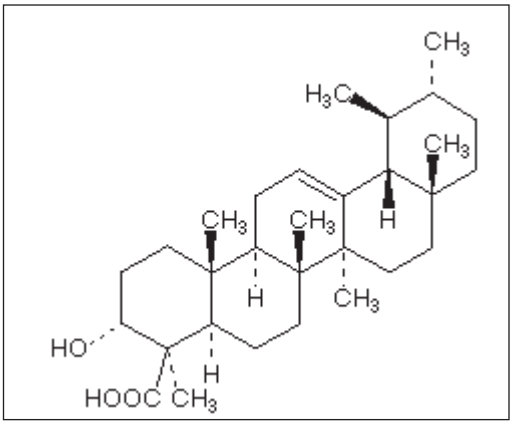


Fig. 21 *Boswellic acid.*

Committee on Toxicity of chemicals in food, consumer products and the environment. Working group on phytoestrogens Cellular & molecular mechanisms of phytoestrogen activity The Department of Biochemical Pharmacology, Imperial College School of Medicine prepared a paper for discussion: "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 (statements for comment really) 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-prenylnaringenin > 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 - 10mM (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-prenylnaringenin and equol were > 1000-fold less potent than estradiol and the isoflavones > 10 000-fold less potent.

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 like hot flushes [Watson].

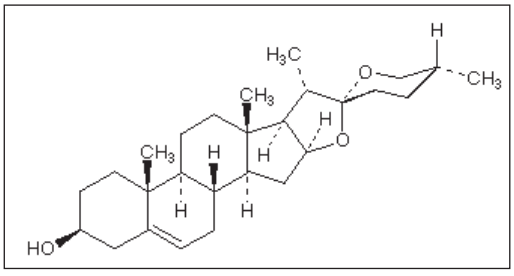


Fig. 22 *diosgenin.*

There are many other sources of diosgenin Trigonella foenum-graecum L. [Fabaceae] Seed 3300-19000ppm, Solanum nigrum L. [Solanaceae] Fruit 4000-12000ppm, Daucus carota L. [Apiaceae] Root 5400-6000ppm, Dioscorea bulbifera L. [Dioscoreaceae] Tuber 4500-4500ppm, 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. It is valuable neuralgic affections, spasmodic hiccough and spasmodic asthma [Grieve].

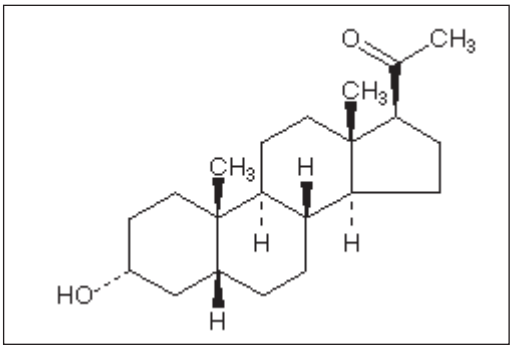


Fig. 23 *pregnanolone.*

It is spasmolytic, a mild diaphoretic. It 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.

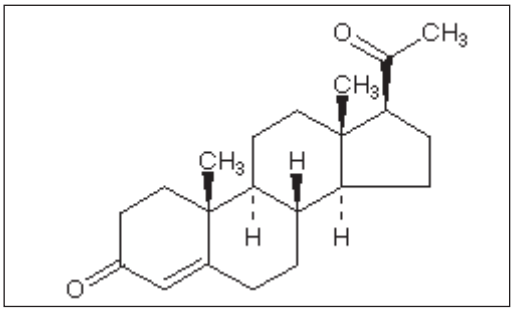


Fig. 24 *progesterone.*

It is interesting to note that Vitex agnus-castus is a source of natural progesterone. Proproprietary 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].

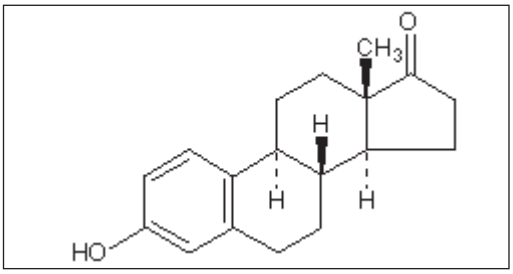


Fig. 25 *estrone.*

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 estrone).

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 for the itch. 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 antioxidant and eicosanoid enzyme inhibition properties of pomegranate (Punica granatum) fermented juice and 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].

Other plants that contain estrone

Dukes data base [Phytochemical and Ethnobotanical Databases] shows the following plants as containing estrone.

Punica granatum L. Pomegranate (Seed) 17ppm, 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 aging. Studies have shown that the decrease of these hormones plays an important role in skin endogenous aging, 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-oxidizing, firming, and soothing properties, extracted from the kernel: phytosterols, phytosteroids, ursolic acid, isoflavons, policosonols, pro-vitamin A and vitamin E.

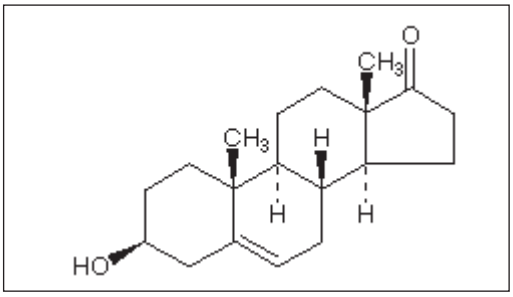


Fig. 26 *Prasterone or Dehydroepiandrosterone (DHEA).*

Some studies suggest that DHEA administration would have a beneficial effect against signs of aging. DHEA is known for its capacity to promote keratinization 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-aging molecule. There was a decrease of wrinkles within only

five weeks of Date Palm kernel extract application and also improved 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].

Plants with a future for topical application

In view of the benefits seen with those plants containing genistein and daidzein, we looked at other plants that might have potential as topical materials and also looked to see if they contained phytosterols and/or phyto-hormones.
The results were promising.

Calabar Bean (Physostigma venenosum)

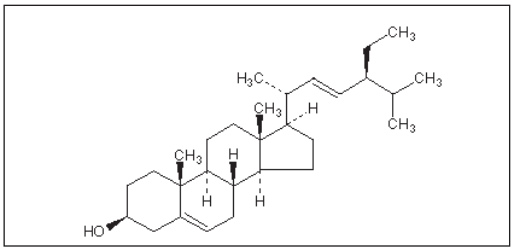


Fig. 27 *Stigmasterol.*

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

Suma or Brazilian Ginseng (Pfaffia panniculata)

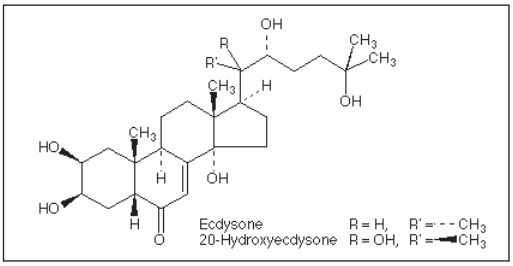


Fig. 28 *β-ecdysterone.*

Other plants that contains β-ecdysterone: 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)

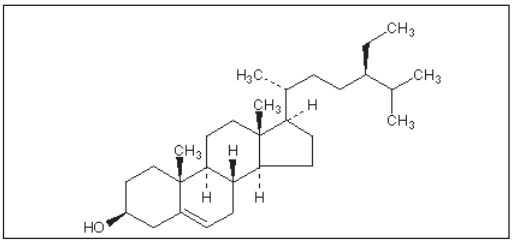


Fig. 29 *β-sitosterol.*

Major plants that contain β-sitosterol: Annona cherimola MILL. [Annonaceae] Seed 10000-14000ppm, Crataegus laevigata (POIR.) DC [Rosaceae] Flower 6500-7800ppm, Crataegus laevigata (POIR.) DC [Rosaceae] Leaf 5100-6200ppm, Nigella sativa L. [Ranunculaceae] Seed 3218-3218ppm, Oenothera biennis L.

[Onagraceae] Seed 1186-2528ppm, Salvia officinalis L. [Lamiaceae] Leaf 5-2450ppm, Morus alba L. [Moraceae] Leaf 2000ppm, Senna obtusifolia (L.) H.IRWIN & BARNEBY [Fabaceae] Seed 1000-2000ppm, Fagopyrum esculentum MOENCH. [Polygonaceae] Seed 1880ppm, Ocimum basilicum L. [Lamiaceae] Leaf 896-1705ppm, Zea mays L. [Poaceae] Silk Stigma Style 1300ppm, Salvia officinalis L. [Lamiaceae] Stem 1214ppm, Ocimum basilicum L. [Lamiaceae] Flower 1051ppm, Syzygium aromaticum (L.) MERR. & L. M. PERRY [Myrtaceae] Essential Oil 1000ppm, Hippophae rhamnoides L. [Elaeagnaceae] Seed 550-970ppm, Glycine max (L.) MERR. [Fabaceae] Seed 900ppm, Nepeta cataria L. [Lamiaceae] Shoot 900ppm, Glycyrrhiza glabra L. [Fabaceae] Root 500ppm, Ocimum basilicum L. [Lamiaceae] Root 408ppm, Viola odorata L. [Violaceae] Plant 330ppm, Cnicus benedictus L. [Asteraceae] Seed 243ppm, Ocimum basilicum L. [Lamiaceae] Sprout Seedling 230ppm, Withania somnifera (L.) DUNAL [Solanaceae] Root 200ppm, Serenoa repens (W. BARTRAM) SMALL [Arecaceae] Fruit 189ppm, Turnera diffusa WILLD. EX SCHULT. [Turneraceae] Shoot 33ppm, Agrimonia eupatoria L. [Rosaceae] Shoot 25ppm, Medicago sativa subsp. sativa [Fabaceae] Fruit 5ppm. [Phytochemical and Ethnobotanical Databases]

Lima Bean or Butter Bean (Phaseolus lunatus)

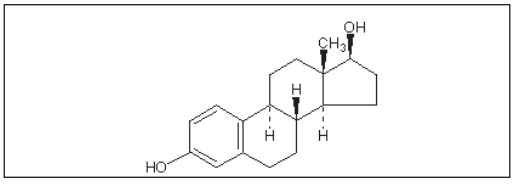


Fig. 30 *Estradiol.*

Other plants that contains estradiol: 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]

Hops (Humulus lupulus)

The hop contains β-sitosterol, estradiol, stigmasterol and estrone. In addition it contains many other materials that are known for their sedative and relaxing attributes.

Regular doses of the herb can help regulate the menstrual cycle [Keville]. It was the girls and women picking hops who first discovered that hops have an effect on genital organs. Before machines were introduced, hop pickers used to spend several weeks at this work, and it had always been known that menstrual periods would come early in young girls while they were doing this work. The reason is that hops contain plant hormones, particularly when very fresh, and these are similar to oestrogens. Considerable amounts have been found, 30,000 to 300,000 i.u. of oestrogen in 100g of hops. This also explains why hops will suppress sexual excitement in men. It has been shown that there are substances called anti-androgens that are able to cancel the effects of the male hormone (androgen) [Weiss].

It was found that hop extract not only recovered the proliferation of hair follicle derived keratinocyte (HFKs) suppressed by androgen but also stimulated the proliferation of HFKs. Furthermore, the effects of hop were evaluated using both animal tests and human volunteers in vivo. It was demonstrated that hop showed a potent acceleration on hair growth. [Okano et al]

Sarsaparilla (Smilax ornate)

It is used in concoctions with other plants as a tonic or aphrodisiac [Seaforth].

Sarsaparilla was formerly used in the treatment

of syphilis [Carrington], gonorrhoea [Honychurch], rheumatism and certain skin diseases. Used in soft drinks, the genins are also used in the partial synthesis of cortisone and other steroids [Evans]. As part of a wider treatment for chronic rheumatism it should be considered as it is especially useful for rheumatoid arthritis. It has been shown that Sarsaparilla contains chemicals with properties that aid testosterone activity in the body [Hoffman].

Sarsaparilla contains saponins, sarsaponin and parallin, which yield isomeric sapogenins, sarsapogenin and smilogenin. It also contains sitosterol and stigmasterol in the free form and as glucosides. It is antirheumatic, antiseptic, antipruritic and is indicated for psoriasis, and other cutaneous conditions. Like other steroidal plants it is indicated for chronic rheumatism and rheumatoid arthritis. It is specifically used in cases of psoriasis especially where there is desquamation [British Herbal Pharmacopoeia].

Appendix

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

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