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"Functional Botanicals – their chemistry and effects"

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Introduction

To many, a walk through the park or the wood is a fragrant, colourful and scenic experience. To some of us it is also an absorbing tour of sophisticated chemical factories that provide a pharmacy of cures to the many skin complaints and diseases that have plagued man since time began.

This paper will examine the effects that these plants can have on the skin and its underlying tissue, concentrating on the symptoms rather than the disease or problem itself and suggesting some of the chemical structures that are responsible.

Like an orchestral symphony, there may be major instruments responsible for the centre of focus, but in nearly all cases it is the harmony of many players that produces the finest results. The pharmaceutical industry regulators would have us play Beethoven's (Pastoral) 6th Symphony on a bassoon, a single voice that could be identified and specified to the finest detail – naturally, that just does not work.

Age spots, liver spots, skin blemishes, freckles

As we grow older, so the process of cell replication and many other complex cellular pathways breaks down and the body begins to make mistakes. In the same way that our reactions slow down as we age, so too our cells make errors and function more slowly. Young vibrant elastic collagen becomes progressively sluggish and inelastic, skin becomes more lined and wrinkled, colour and freshness are slowly replaced with dull, lifeless skin often speckled with discoloured patches where the deposition of melanin has become uneven and erratic. These discoloured areas are commonly referred to as "age spots" or "liver spots", technically it is known as chloasma or melasma. Similar effects are seen in pregnant women, where the effect is known as melasma gravidarum (the mask of pregnancy).

This erratic deposition of melanin is also seen in some scar tissue, where the skin has been subjected to surgical or other injurious trauma.

There are dozens of plants mentioned for the cure and control of this condition, though the chemical entity responsible for the effect has not been identified. The list is varied and apparently unconnected, so the comparison of plants by their constituents does not really give too many clues.

Acacia farnesiana has been studied as the wax obtained from the distillation of the flowers for their essential oil. In the trial a cream containing 7.5% of this wax was used and had a positive effect in 70% of the volunteers.

Taraxacum officinale or Dandelion has been cited [Hutchens], but the evidence is weak.

Freckles are a reversible melasma induced by the photoreaction of the skin to sunlight, the plants mentioned include *Tragopogon pratensis* or Goat's beard [Chiej], *Anemone hepatica* or Kidneywort [Stuart], *Asphodelus albus* or Asphodel [Chiej], *Phaeolus vulgaris* or Common Haricot [Palaiseul], *Drosera rotundifolia* or Sundew [Schmidt], *Geum urbanum* or Avens [Grieve].

One of the most popular materials is *Sambucus nigra* or Elderflower [Grieve, Back] and many supplier data sheets also cite this material.

Knautia arvensis or Field Scabious is mentioned [Phillips et Foy], however, this may be misguided, since another reference mentions the use of the juice of Scabious, with the powder of Borax and Samphire (*Crithmum maritimum*?) [Grieve]. The use of borax for cases of chloasma has been cited before [Harry].

Another potentially big player in this scenario is *Anagallis arvensis* or the Scarlet Pimpernell, which is mentioned by a number of authors [Conway; Stuart; Genders]. *Nasturtium officinale* or Watercress may also be worth a visit [Back] since numerous supplier data sheets also advocate its use. An old favourite is *Citrus limonum* or Lemon [Valnet; Genders], as is *Nymphaea alba* or *Nymphaea odorata* (the Fragrant Water Lily) which has a few citations [Culpepper; Foster et Duke; Hutchens].

Legusticum levisticum or *Levisticum officinale* (Lovage) seems to be quite a popular British remedy and is mentioned by a number of authors [Leyel; Back; Gordon]

Other freckle treatments include *Sapindus mukorossi* or the Soap Nut Tree [Smith], *Galium aperine* or Cleavers [Back; Hutchens], *Lupinus* sp or Lupin [Scott], the juice of the plant *Chenopodium album* or Fat Hen has been used [Perry et Metzger]

The juice of Papaya or *Carica papya* may have influence (because of the proteolytic enzyme that it contains?) and has been recommended by a number of suppliers and authors [Grieve; Lust; Quisumbing]. While in the area of fruit, it might be worth visiting the humble Strawberry or *Fragaria vesca* [Leyel; Bremness; Palaiseul; Levy]

Materials recommended for skin whitening (see below) are also frequently cited.

Anti-acneic, spots, pimples

There is tremendous interest in products that combat acne and, as might be expected, the literature abounds with materials that have been used with varying degrees of success.

Crataegus monogyna or Hawthorn is used as a decoction of the dried flowers or berries as a facial lotion [Back] and one supplier suggests that the flavonoids vitexin-

4’-rhamnoside, quercetin, quercetin-3-galactoside and catechin derivatives are responsible for this action. Another supplier achieved a 35% reduction in acne lesions and 69% reduction in *Propionibacterium acnes* after 4 weeks of application.

Viola tricolor or Heartsease is widely respected for problem skin conditions and was formerly official in the U.S.P. A number of authors cite the plant for acne and other skin eruptions [Fluck; Back; Wren 1985; BHP 1983; Launert]. It is suggested [Weiss] the triterpenoidal saponins present might explain the successful use of heartsease or wild pansy tea for these skin conditions, however other sources [Schauenberg et Paris] suggest that the flavonic glycoside (violaquercetin) or the salicylate derivatives [Chiej] might also have a part to play.

A full breakdown is given as [Wichtl]: 0.065 to about 0.3% salicylic acid and its derivatives such as methyl ester and violutoside (=violutosin, the glucosidoarabinoside of salicylic acid methyl ester), further phenolic carboxylic acids such as *trans*-caffeic acid, *trans*- and *cis*-p-coumaric acids, gentisic acid, protocatechuic acid, etc.

Ca. 10% mucilage, made up of glucose (35%), galactose (33%), arabinose (18%), and rhamnose (8%). 2.4-4.5% Tannins, Flavonoids: rutin (=violaquercetrin), violanthin, scoparin, saponarin, and the C-glycosides vitexin, saponaretin, orientin, and iso-orientin, and also vicenin. Anthocyanidin glycosides; carotenoids; violaxanthin and four geometrical isomers, zeaxanthin, etc.; coumarins: umbelliferone; small amounts of saponins, ascorbic acid, and α-tocopherol.

It is also suggested that this herb makes a good cosmetic cleansing preparation and for use in preparations for thinning hair [Bunney]. The herb also has application in cases of discharging eczema [Mills; Bremness; Foster et Duke]. In the USA, *Viola pedata* has been used in a similar way [Wood et Bache], but surprisingly the British Pharmaceutical Codex 1923 only mentions *Viola odorata*. According to another author [Ody], the Chinese use *Viola yedoenisis* (Zi Hua Di Ding) with similar success, and also use the herb on abscesses, boils and carbuncles [Reid].

If indeed the triterpenoidal saponins are responsible for anti-acneic activity, then we would expect a plant like *Saponaria officinalis* or Soapwort, which is high in this compound to be useful. The evidence is convincing and many authors substantiate the theory [Lawrence; Grieve; Wren 1994].

Anti-bacterial, anti-fungal, antiseptic

Two papers on natural preservatives [Dweck 1995,1; Dweck 1995,2] which give a detailed background to potential areas for future investigation. For the purposes of this paper, two widely commercially available materials will be considered. The first is from *Citrus* spp, particularly *Citrus paradisi* or grapefruit.

Naringenin is an active material in Grapefruit seed extract or *Citrus paradisi* and it is probably this flavonoid that is responsible for the antibacterial activity. The second material, which is found in Lemon or *Citrus limonum*, is called hesperitin. One might expect this material to have antibacterial activity, since it is very similar in structure to naringenin - and indeed it does. You might be thinking that this is not so unexpected, since both plants are citrus fruits. However, hesperetin is also found in Shepherd’s

Purse (*Capsella bursa-pastoris*), Cleavers, Hyssop or *Hyssopus officinale,* and Linden or *Tilea europeae.*

Naringenin is found in plants like Hops or *Humulus* l*upulus*, Liquorice or *Glycyrrhiza uralensis* and certain *Epimedium* species. All of these plants show mild antibacterial activity, because the content of these compounds is not as high as it is in the citrus species.

There has been considerable debate on the validity of the final preparations, which appeared to fluctuate in its efficacy. However, it was believed that many of the problems associated with the extraction of the active materials were dependent on the speed with which the harvested crop was processed. Degradation of active phytochemicals can be extremely rapid in stored crops [Dweck 1994].

Another material that has become increasingly interesting is hinokitiol. Hinokitiol is a white crystalline acidic substance first isolated from the essential oil of Formosan Hinoki (*Chamaecyparis taiwanensis* Masamune et Suzuki) by Nozoe in 1936. This substance was also found in the essential oil of Aomori Hiba tree (*Thujopsis dolabrata* SIEB et ZUCC) at a later date. Both of these species of trees are known for their high degree of resistance against wood decay. Subsequent research led to the proposal that the structure was a seven membered carbocycle containing two double bonds (very rare in natural products), as well as carbonyl and enol radicals. In 1944, after re-examination and revision, It was determined [Nozoe] to be 2-hydroxy-4-isopropy1 2,4,6-cycloheptatrieni-one (4-isopropyltropolone) with 3 double bonds.

The commercial preparation is now synthetically produced and so would be classified as “nature identical”.

Nature is rich in parabens and so these may also be considered in certain cases to be nature identical [Nipa], benzyl alcohol and benzoic acid are present in a number of balsamic resins. While potassium sorbate has not been reported in any plant materials, sorbic acid (is present in *Sorbus aucuparius* or Rowanberry) has been reviewed by several authors [Luck; Nowak]

Anti-erythema or anti-redness

There are many causes of skin redness, some of them deliberately induced to bring muscle-pain relief by the use of rubefacients (see below) which produce increased blood flow to the site of application.

Other causes of skin redness are unwanted skin irritations induced by adverse cellular reactions. Clearly, these reactions are physiological in nature and so are, strictly speaking, outside the remit of a cosmetic product. However, many cosmetic houses recognise that the skin can be protected against this phenomenum and we see terms like “stressed”, “irritable”, “angry” and “sensitive” used to describe this condition. Redness is often accompanied by inflammation, but anti-inflammatory plants will also be covered as a separate topic below (even though the two events are often simultaneous).

The plant world has so many useful materials to soothe and calm the skin, that it is impractical to even attempt to mention them all. There are a few that have been extensively studied, *Aloe barbadensis* or Aloe vera, *Matricaria recutita* or German Chamomile and Liquorice (*Glycyrrhiza glabra* or *G. uralensis*).

Aloe vera

The clinical data for Aloe vera is extensive as a small part of the work on burn treatment shows. These burns, induced by thermal radiation, UV-radiation or Beta radiation (as in radiotherapy) show remarkable improvement, when treated with Aloe, indeed, aloe vera shows a protective, ablative effect in these cases, if used prior to treatment.

The effect of aloe lectin on deoxyribonucleic acid synthesis in baby hamster kidney cells. It is suggested that this lectin may be responsible for the therapeutic effect of aloe gel on burns [Yagi et al.].

The ability of Aloe barbadensis gel extract to prevent suppression of contact hypersensitivity (CHS) and delayed-type hypersensitivity (DTH) responses in mice by ultraviolet (UV) irradiation has been investigated [Strickland]. Topical application of 0.167-1.67% Aloe gel after each irradiation significantly reduced this suppression. Aloe treatment partially preserved the number and morphology of Langerhans and Thy-1+ dendritic epidermal cells in skin, compared to those in the skin of mice given only UVR or UVR plus the vehicle. These studies demonstrated that topical application of Aloe barbadensis gel extract to the skin of UV-irradiated mice ameliorates UV-induced immune suppression by a mechanism that did not involve DNA damage or repair.

An experimental study was designed using Hartley guinea pigs, who received full-thickness burns covering 3 percent of their body surface area by direct contact with a hot plate [Rodriguez-Bigas] A total of 40 animals were equally divided among four modalities of closed burn wound management as follows: group I: silver sulfadiazine (Silvadine); group II: aloe vera gel extract (Carrington Dermal Wound Gel); group III: salicylic acid cream (aspirin); and group IV: plain gauze occlusive dressing only. The dressings were changed daily, and the size and appearance of each burn wound were recorded until complete healing. On the sixth postburn day, quantitative burn wound cultures were made. The average time to complete healing in the control group was 50 days, and the only significant difference was found in the aloe vera-treated animals, which healed on an average of 30 days (p less than 0.02). Wound bacterial counts were effectively decreased by silver sulfadiazine ($p = 0.015$) and by aloe vera extract ($p = 0.015$). From the data it appeared that aloe gel extracts permitted a faster healing of burn wounds.

It is generally accepted that in the canine species with a 50% or more partial or full thickness burn over the body surface area (BSA), recovery is remote and euthanasia is recommended [Cera et al.]. They presented two case histories where a therapeutic modality employing an Aloe vera cream (Dermaide Aloe) and tablets, reversed the dermal ischemia of burns due to prostaglandins and abrogated a *Pseudomona aeruginosa* infection in animals with over a 35% burn. Both bacteriological and immunohistochemical data presented confirmed the bactericidal and antiprostaglandin

effect of Aloe cream/ Dermaide Aloe) and substantiated its efficacy in the management and treatment of thermal injuries in the canine species.

Erythema is also a significant factor in radiotherapy treatment and numerous studies have confirmed the prophylactic benefits of Aloe vera in this protocol.

The protective qualities of *Aloe arborescens* (a close relative of aloe vera) against radiation were reported [Sato *et al*., 1990], when the protective effects of this species on mouse skin injury induced by soft X-irradiation were examined. Formulae of mixtures with aloe which may be used in domestic conditions for increasing the defensive forces of the body during radiation lesions have been published [Iena].

Experimental acute radiodermatitis following Beta Irradiation versus histopathological study of the mode of action of therapy with Aloe vera was examined [Lushbaugh and Hale]. Their experiments showed objectively that *Aloe vera* has a remarkably curative effect upon radiodermatitis in the rabbit.

The debate has raged on for many years, but the conclusions reached, suggest that it is the mannose-6-phosphate and other polysaccharides (in combination) that are responsible for the beneficial effect [Reynolds & Dweck].

German Chamomile

German Chamomile (*Matricaria recutita*) and its close relative Roman Chamomile (*Anthemis nobilis*) have similar constituents present in the flowers. *Matricaria* has been reviewed recently [Dweck, 1998; The Council of Europe] where the key components were identified as (-)-α-bisabolol, matricin (the precursor to chamazulene) and chamazulene in the essential oil and the flavonoid apigenin and its glycosides in the aqueous extract. An excellent review paper [Carle et Gomaa] confirms that the plant should be standardised against apigenin-7-glucoside and (-)-α-bisabolol. The chamazulene (which is a brilliant blue colour) is not present in the flowers, but is formed during the process of steam distillation [Bradley], there is also a red component to the oil called chamaviolin. An excellent review of the chemistry has been published [Leung et Foster] and the authors add that matricin has a significantly stronger anti-inflammatory effect than chamazulene. This might suggest that the essential oil produced by critical carbon dioxide extraction is likely to be more effective than the traditional distilled version [Reverchon *et al*.].

It is suggested that the essential oil and its components are more effective than the components of the aqueous extract [Tyler, Brady et Robbers]. One of these authors [Tyler] uses German Chamomile as an example of the wide rift that exists between the USA and Europe in the acceptance of herbal materials in medicinal practice.

There are numerous studies that confirm the anti-inflammatory effects of *Maricaria recutita* and its components. Antiphlogistic activity of the flavones [Merfort *et al*.], anti-inflammatory effect and mechanisms for chamazulene [Safayhi *et al*.], and comparison of a Chamomile cream to hydrocortisone (which is a traditional treatment for erythema and inflammation) [Aertgeerts *et al*.] are but a few.

Liquorice or Licorice

Liquorice (*Glycyrrhiza glabra* or *G. uralensis*) has been the subject of many reviews in the literature [Scher; Newall. Anderson and Phillipson]. The constituents are numerous [Wren, 1994]

Constituents: (i) Triterpenes of the oleanane type, mainly glycyrrhizin (= glycyrrhizic or glycyrrhizinic acid), and its aglycone glycyrrhetinic acid (= glycyrrhitic acid), liquiritic acid, glycyrrhetol, glabrolide, isoglabrolide, licoric acid, and phytosterols. (ii) Flavonoids and isoflavonoids; liquiritigenin, liquiritin, rhamnoliquiritin, neoliquiritin, licoflavonol, licoisoflavones A and B, licoisoflavanone, formononetin, glabrol, glabrone, glyzarin, kumatakenin and others. (iii) Coumarins; liqcoumarin, umbelliferone, herniarin, glycyrin. (iv) Chalcones; liquiritigenin, isoliquiritigenin, neosoliquiritin, rhamnoisoliquiritin, licuraside, licochalcones A and B, echinatin and others. (v) POlysaccharides, mainly glucans. (vi) Volatile oil, contains fenchone, linalool, furfuryl alcohol, benzaldehyde and others. (vii) Miscellaneous; starch, sugars, amino acids etc.

Both glycyrrhizin and glycyrrhetinic acid are anti-inflammatory and antiallergic. Liquorice has antiulcer activity and a derivative of glycyrrhetinic acid, carbenoxolone, is used clinically for ulcers, including aphthous ulcers. Liquiritn also has significant anti-inflammatory activity in the rat paw oedema test.

These effects have indicated the use of liquorice in the treatment of psoriasis [Taylor et Evans], though surprisingly it was an active compound X, (structure yet to be fully elucidated) that was successfully extracted and purified using a bioassay guided technique, and has been confirmed as not being glycyrrhetinic acid.

It may be that this material is glyderinine [Azimov *et al*.], though the exact structure is not known. In experiments on various animals glyderinine, a derivative of glycyrrhizic acid isolated from *Glycyrrhiza glabra*, was found to exert a pronounced anti-inflammatory effect exceeding that of hydrocortisone and amidopyrine. Similar to other anti-inflammatory agents, glyderinine possesses analgesic and antipyretic properties. The drug is of low toxicity and exerts the antiallergic effect. Glyderinine was successfully tried and recommended for a wide use as an ointment for treating skin diseases.

The additional presence of flavonoids and saponins further masks the identity of a single active and it is very likely that a whole range of potent phytochemicals are involved in the beneficial effects of liquorice on the skin.

Anti-inflammatory

As mentioned earlier, it is unusual not to have inflammation and redness occur together, however, there are a number of materials that appear to be more specific for their anti-inflammatory effect, than for their anti-erythema properties and a number have already been mentioned above.

Gotu Kola

Gotu Kola or *Centella asiatica* is a relatively new addition to the cosmetic scientists armoury, but is showing great promise as a treatment for numerous skin problems where inflammation is a problem [Dweck, 1996; D'Amelio].

It has also been used for the treatment of striae [Mallol *et al.*] for treating leprosy and other difficult skin eruptions, treating abscesses and ulcerous sores on the surface of the skin. [Chopra]. It also has benefit smoothing, soothing, and purifying the skin and is also thought to be a granulation promoting agent, anti-irritant, anti-oedema, antiseptic [Council of Europe].

The active components responsible for this activity are a glycoside, asiaticoside, the aglycone of which is asiatic acid (triterpenic acid) and in some plants a related glycoside centelloside and the triterpenic acids: centoic and centellic acid [Bep-Oliver].

Topically, asiaticoside has been shown to accelerate the wound-healing process and significantly improved tensile strength of tissues, promoting keratisation and stimulating rapid and healthy growth of the reticuloendothelium. A leaf extract (standardised to asiaticoside) was evaluated in clinical patients with soiled wounds and chronic atony, resistant to treatment; results showed complete healing in 64% and improvement in 16% of 20 patients [Leung et Foster].

The leaves can also be used to treat sore eyes [Zakaria *et al*].

It may even be possible that this material can be used as a cicatrising agent (see below) and for the treatment of keloids [Bosse *et al.*]. *Centella asiatica* extracts are used for the treatment of skin ailments, particularly ulcers, wounds, and for prevention of keloid and hypertrophic scars. *Centella* extracts have been found to accelerate wound healing, particularly in cases of chronic, post-surgical and post-traumatic wounds. Extracts have also been successfully used as a therapy in the treatment of second- and third-degree burns [World Health Organisation monograph].

Ginkgo biloba

Another new and interesting plant is *Ginkgo biloba*, which has numerous benefits on the skin. It has free-radical activity (see below) [Pincemail et Deby].

The main constituents of *Ginkgo biloba* leaves belong to the flavonoid and terpenoid groups. Steroids and phytic acids are also present [Reuter]. *Ginkgo biloba* constituents act on various sites in the organism: they act directly on the blood, affecting the blood cells and blood vessel walls, and on the tissues. The effect on the blood and the blood vessels composes maintenance of the microcirculation, a reduction in blood viscosity, protection against haemolysis (free-radical scavenging), the inhibition of thrombocyte aggrevation, and an increase in the rate of blood flow. Various ginkgo constituents may be responsible for the free-radical antagonism, for example the flavonoids and the ginkgolides.

The actions of flavonoids protect capillaries against fragility, act as potent antioxidants, have anti-inflammatory action, reduce oedema caused by tissue injury, and act as free radical scavengers [Pang *et al*.].

Anti-oxidants, detoxifying, anti-pollution, free radical scavengers.

A group which contains useful detoxifying chemicals are the polyphenols, which can also include many of the tannins. There are numerous references to support the use of these materials and in many cases it is the polyphenols which are cited for this action.

Green Tea (*Thea viridis*)

The best known polyphenols probably come from Green Tea or *Thea viridis*, a fast-growing additive in today's skin care repertoire.

Tea contains caffeine, and also contains high levels of tannins (approx. 10-25%) which consist of catechin (flavanol) and gallic acid units. Flavonoids (quercetin, quercitrin, rutin etc.) are also present.

Green tea infusion contains intact catechin polyphenols, which give rise to its bitterness and astringency. Six catechin polyphenols have been isolated from green tea; (-)-epigallocatechin, (-)-epicatechin, (-)-epigallocatechin-3-O-gallate (EGCG), gallocatechin-3-O-gallate (GCG), methyl-epigallocatechin-3-O-gallate, and (-)-epicatechin-3-O-gallate (ECG). These substances were tested for their antioxidant activity, and the gallic acid esters EGCG and EGC were found to be the strongest antioxidants, with EGCG being over 200 times more active than Vitamin E in an in vitro model.

Clearly the polyphenols are acting as antioxidants and numerous researchers would bear out this fact. [Hara; Salah *et al*.; Xie *et al*.; Zhao *et al*.]

A flavonoid is identical to a bioflavonoid, furthermore, a flavonoid by definition is a polyphenol, since it contains more than one benzene ring in its structure. However, many would regard polyphenols as primarily referring to tannins.

Many of the studies relate to the ingestion of tea [Hertog *et al,*; Hirose *et* al.], where the antioxidant properties are well-proven.

Grape (*Vitis vinifera*)

Similar flavonals can be found in red grape skin, which contains xanthophyll, carotene, vitamins A, B1, B2 and C. In some country areas, the sap is collected. This contains the same substances as the grapes. It is used for eczema, and for intestinal haemorrhages accompanying dysentery. Drops of the sap are also used for eye infections [Schauenberg and Paris].

An anthocyanidin

The seeds contain another polyphenol sometimes referred to as "pycnogenol" (also found in pine bark extract), which is a proanthocyanidin. (Pycnogenol is in fact a trade

name). The other main compounds are quercetin, catechin and epicatechin, as mentioned above.

Vitis vinifera has yet another molecule that has valuable potential as a detoxifying agent and that is the presence of a carotenoid called xanthophyll.

The presence and benefit of these materials has been known for generations, but it is only recently that the link between these compounds and free radical scavenging has been associated.

Carrot (Daucus carota)

The humble carrot contains an orange material called β-carotene, which is also known as provitamin A and is often used in UV sunscreen preparations as a boost to the efficacy of the product. It has long been known that this material is also a powerful antioxidant.

The pure juice in emollient preparations is used for irritated and dry skin. Up to 5% oil tincture in sun preparations, emollient products for sensitive skins. It has other possible effects, such as cheratoplastic, anti-irritant, and antimicrobial.

Tomato *(Lycopersicon esculentum)*

Tomato contains carotenoids as well, however, in this case the active material lycopene is another carotenoid that is four times more powerful than α-carotene and ten times more portent than β-carotene. Besides the classical plant active principles like polyphenols and proteins, are also extracted, in a significant quantity, compounds having high bacteriostatic properties (tomatine).

It also contains tomatine and tomatidine

These materials by the very nature of their structure would also be classed as polyphenols. Tomatine and tomatidine inhibit the growth of various fungi and bacteria [Merck].

Turmeric *(Curcuma longa*)

A number of soluble fractions of turmeric, including curcumin, have been reported to have antioxidant properties [Bone] and non-steroidal anti-inflammatory action. Turmeric inhibits the degradation of polyunsaturated fatty acids.

In parts of Africa, turmeric has been successfully tested for healing rashes due to allergies and the psoriais inflammation and itching accompanying arthritis [Chandra et Gupta]. Other authors confirm the anti-inflammatory action [Balacs]

Garlic (*Allium sativum*)

The key detoxifying ingredient in garlic is S-allyl cysteine (SAC), which has been proven to protect against oxidation, free radicals, pollution, cancer and cardiovascular diseases.

SAC demonstrated radical and hydrogen peroxide scavenging activities [Ide et al, 1996, 1] and in a later paper demonstrated a scavenging effect on hydrogen peroxide and also inhibited the chain oxidation induced by a hydrophilic radical initiator [Ide et al, 1996, 2]. It was suggested that SAC has antioxidative efficacy.

The presence of these sulphur compounds abundant in garlic might also include alliin (S-allyl-L-cysteine sulphoxide) and allicin (diallyl thiiosulphinate), which have potent antifungal and antibacterial properties [Dewick]. These properties would also fit the definition of detoxifying.

Rice (*Oryza sativa*)

Rice has many interesting ingredients, especially ferulic acid, *gamma*-oryzanol and phytic acid, which are found concentrated in the rice bran and its oil. Ferulic acid is used as a food preservative and so under the definition would satisfy the term detoxifying.

The *gamma*-oryzanol is believed to be the most active component responsible for rice bran's anti-oxidant effects.

The presence of phytic acid, a strong chelating agent, will not only help to mop up unwanted metal ions, but will also help to attack the outer cell membrane of bacterial cells.

Anti-pruritic or anti-itching

The association of itching with skin irritation and insect bites is well known and there are (as you might expect) many herbal materials used for this condition, some of which have been mentioned previously (i.e. *Aloe barbadensis*, *Centella asiatica* and *Matricaria recutita*).

Tea Tree oil

One of the major essential oils is *Melaleuca alternifolia* or Tea Tree oil. Tea Tree Oil is used in clinical practice for vaginal warts, pruritis and infections [Cabot]. She described the oil as useful for dandruff and fungal infections of the skin, particularly athlete's foot. She also mentioned Tea Tree oil mouth gargle for the treatment of various mouth and gum infections, and a Tea Tree Oil cream for the treatment of varicose ulcers in elderly patients.

Tea Tree is also a useful material for acne [Anon] we read of tea tree oil and acne. Tea tree oil a traditional remedy for skin complaints, is effective against acne and is better tolerated than routine treatment, dermatologists have found.

A trial of 124 patients reported in the medical journal of Australia [Basset *et al*., 1990] tested a 5% gel of tea tree oil against 5% benzoyl peroxide lotion. Both treatments produced significant improvements after 3 months. Benzoyl peroxide was more effective in non-inflamed lesions. But fewer patients reported unwanted effects, including dryness, itching, stinging, burning and redness, with tea tree oil (44% versus 79% for

benzoyl peroxide). The oil, extracted from Melaleuca alternifolia, contains antimicrobial plant terpenes, and may be a valuable alternative to orthodox treatment, the authors say (Lancet 1990,336,1438) [Bassett *et al*., 1991].

The crushed foliage is aromatic because of the high content of oil, which is a good bactericide and germicide and is used externally in the treatment of cuts, abrasions, sores, boils and abscesses [Woodward]. The oil is rich in cineol, terpinene-4-ol, cymene, and other sesquiterpenes and sesquiterpene alcohols [Onions].

True tea tree oil does not irritate the mucous membranes and it can be used neat on the skin or a few drops added to tampons can be used for topical treatment of vaginal thrush and is also effective on cold sores, warts, verrucas and insect bites. The oil, used neat on a comb, or added to shampoos is a good way to treat head lice. Tea tree oil is also used (in combination with other herbs) for sore throats [Ody, 1996].

Witch Hazel or *Hamamelis virginiana*

Witch hazel has astringent and haemostatic properties. These properties can be attributed to the tannins present. In addition the material can be used for treating itching, irritations, and minor pains. Also used in eye lotions. In folk medicine the extract is used to treat eye inflammations, insect bites, minor burns and other skin irritations, usually as a decoction, poultice or ointment [Leung].

Similar recommendations are made in another book [Harry]. Hamamelis is used in cosmetics and toilet preparations on account of its very mild astringent effects, and has also been recommended for certain skin conditions, such as boils, ulcers, itching eczema, bruises etc.

A fairly recent paper [Swoboda *et al*.] examined twenty two patients with atopic dermatitis, who were treated for three weeks using a standardised *Hamamelis virginiana* extract and bufexamac ointment simultaneously. Comparison of both forearms of each patient was made by observing symptoms (redness, desquamation, lichenification, pruritis, infiltration) on a 10 cm analogue scale and testing any differences statistically. No differences could be found, either in the therapy judged overall or in the intensity of the symptoms, and in all a clear improvement of the symptoms on both forearms was achieved. Hamamelis extract is strongly astringent and anti-inflammatory and stimulates wound healing.

Astringents, skin firming, toning and refreshing

The major components of astringency are alums, alcohols and tannins.

Witch Hazel has already been described above, but additional information recommends the material as an after-shave [Buchman]. Both leaves and bark are astringent, tonic and sedative. Its astringent action is due to its relatively high tannin content, and it is of great value to sufferers of varicose veins. It is good for bruises, small wounds, swellings and sprains. It is employed in some toilet preparations as a skin tonic, to tighten up tissue and remove red veins. Mixed with rose water it is refreshing as an eye bath, or as eye pads for tired eyes [Gordon].

The dried leaves of *Hamamelis virginiana* containing tannins, gallic acid, a bitter principle, and a trace of volatile oil are used. Hamamelis has astringent properties. It is used in ointment and suppositories in the treatment of haemorrhoids. Hamamelis water is used as a cooling application and has been applied as a haemostatic [Martindale].

Those materials with high tannin content are ideal for use as astringents and nature has plenty of examples from which to choose. Cinquefoil (*Potentilla canadensis*) or Tormentil (*Potentilla tormentilla*) is frequently cited [Fluck; Levy; Schauenberg et Paris; Martindale] and also mention that it acts as a styptic to stem haemorrhage [Genders].

Another herbal remedy used as an astringent is Rosebay Willowherb (*Epilobium angustifolium)* [Grieve; Bunney; Chiej]. In Tibet a related species *Epilobium latifolium* is used as an antipruritic and anti-inflammatory [Tsarong].

More commonly available is Bayberry or *Myrica cerifera*, which in addition to tannins contains a flavonoid glycoside myricitrin, which also gives the plant soothing properties. [Newall, Anderson et Phillips; Hutchens]. It is also used for indolent ulcers [Leung; BHP].

Another powerful astringent is Oak or *Quercus robur*, which is much cited in the literature for its powerful astringency [Fluck; Wren; Conway; Weiss]. The galls that often affect oak trees, such as Turkish galls are also rich in astringent tannins and gallotannic acid [Evans], The use of the fruit (acorns) has been used for serious burns and rashes [Heinermann]. The presence of ellagic acid (a tannin derivative) is proposed as the active ingredient [Martindale] which has haemostatic properties and gallotannic and quercitannic acids are also mentioned as the active astringents.

Bruising

The herbals are packed with remedies for bruises and a simple search of the data base came up with over 250 materials that would be suitable.

Solomon's Seal (*Polygonatum multiflorum*) is frequently mentioned [Wiseman; Leyel; Lust] and seems to have global acceptance. Interestingly, it contains saponins based on diosgenin [Wren] and called saponosides A and B, however, unlike the triterpinoidal saponins already discussed, these saponins are steroidal in structure. The presence of glycosides convallarin and convallamarin is mentioned [Keys].

The trained herbalist would undoubtedly reach for Arnica (*Arnica montana*) and this tincture could be applied effectively to sprains, bruises and wounds [Grieve], it is also effective on swellings [Wren]. Some herbalists recommend the use of this material where there is pain [Buchman] and another that arnica will provide counter-irritation hwne applied to skin overlying an inflamed or irritated joint [Winter-Griffith]. Arnica is also cited for use on unbroken chilblains and for weary feet [Ceres]. The oil is too powerful to be used internally [Lautier et Passebecq; Trattler]. Arnica has even been recommended for hair growth and sea sickness [Perry].

Hyssop (*Hyssopus officinalis*) is another domestic remedy that is well cited for bruises [Culpeper; Back]. It contains a glycoside diosmin(e), tannin [Schauenberg et Paris], hesperidin, tannin, β-sitosterol and ursolic acid [Leung] all of which could help

account for its effect. The plant has also been attributed antiseptic properties and may help soothe aching joints [Hooper]. Hyssop was assigned the meaning “cleanliness” by the early Victorians [Forsell].

Cellulite

There are two major plants that are recommended for cellulite and they are Ivy (*Hedera helix*), Horse Chestnut (*Aesculus hippocastanum*) and Butcher’s Broom (*Ruscus aculeatus*). Additional materials that are often added are a source of caffeine to stimulate the tissue either from coffee (*Coffea arabica*) or Guarana (*Paullinia cupana*); a proteolytic enzyme such as papaine from Papaya (*Carica papaya*) or bromelaine from Pineapple (*Ananas cosmosus*).

Other materials from marine sources are also available.

An excellent paper has been published [Carini *et al*.], which examined all of these materials. The author has also published on the subject [Dweck, 1995 (2)].

Triterpene and steroid saponins and sapogenins of plant origin (*Hedera helix*, *Aesculus hippocastanum*, *Ruscus aculeatus*) are claimed to be effective for the treatment and/or prevention of panniculopatia edemato-fibrosclerotica (so-called "cellulitis"). but until now it has never been elucidated the mechanism(s) by which these compounds can be active. In this work they evaluated the inhibitory effects of these plant constitiuents on the activity of elastase and hyaluronidase, the enzyme systems involved in the turnover of the main components of the perivascular amorphous substance.

The results showed that for *Hedera helix*, the sapogenins only non-competively inhibit hyaluronidase activity in a dose dependent fashion; both the saponins Hederacoside C and α-Hederin are very weak inhibitors. The same behavious is observed for serin protease porcine pancreatic elastase: the glycosides are devoid of inhibitory action, while genins are potent competitive inhibitors. Hederagenin a related component has been shown to be anti-inflammatory (though the material was extracted from *Sapindus mukorossi*) [Takagi *et al.*]. These saponins may also have antibacterial activity [Cioaca *et al.*].

Constituents from *Aesculus hippocastanum* show inhibitory effects only on hyaluronidase, and this activity is mainly linked to the saponin escin (or aescin), less to its genin escinol.

By contrast, ruscogenins from *Ruscus aculeatus*, ineffective on hyaluronidase activity, exhibit remarkable, anti-elastase activity. The mechanism of elastase inhibition by triterpene and steroid aglycons, with a nitroanilide as substrate, is discussed.

All these findings provide a biochemical support for the efficacy of these extracts in the treatment of liposclerosis, since the recovery of the integrity of hyaluronic acid and elastin (and of their functional interactions with proteoglycans) might lead to a reconstruction of the extracellular matrix in which the peryadipocyte microvascular system is embedded.

Cicatrisation, vulnerary, wound healing

This is such a massive subject, that only a few examples will be given. Comfrey or *Symphitum officinale* is a major source of allantoin, and this material has been well accepted as a tried and tested healing agent [Fisher; Young].

Allantoin has been used in creams and lotions because of its reputed soothing and healing action [Flesch] reported the denaturation or dispersion of epidermal horny material by saturated aqueous solutions of allantoin. As a result of this and subsequent studies it can be surmised that allantoin has a softening effect upon hardened epidermal tissues in dermatoses. The concentrations employed are 0.01 to 2%. Allantoin has no germicidal or antiseptic properties.

Allantoin that it is a topical vulnerary and is a skin ulcer therapy [Merck, 1989]. In the veterinary field it has been used topically to stimulate the healing of suppurating wounds and resistant ulcers. In the 5th edition 1941, it reported that it was used externally to stimulate cell proliferation in 0.3-0.5% aq. solutions. It was for ulcers, non-healing wounds, fistulas etc. [Merck, 1941]

This is a very old medicinal plant, which has become more widely used again in the treatment of persistent varicose leg ulcers and chronic ulcerations generally. Its use in healing has been shown to be well founded, for in addition to mucilage and other components. [Weiss]. *Symphytum officinale* contains mucilage, allantoin (0.6-0.8%), tannins, starch, and two alkaloids, consolidine and symphytocynglossine. Large amounts of potassium, phosphorus, and vitamins A and C have been reported. The allantoin may provide some effects in the healing of abraded skin. The tannins would be astringent and the mucilage an external demulcent [Spoerke]. The roots and leaves are used in poultices intended to aid in the healing of wounds and ulcers.

Another fascinating plant is *Rosa rubiginosa* or Rosehip seed oil, where extensive studies have been carried out to look at scar healing and improved tissue repair.

Rose hip seed oil has been used to regenerate damaged tissue [Valladares *et al*.] and to repair damage caused by acne [Camacho *et al*.]. Work has also been carried out to prove that it has good effect in the treatment of skin ulcers [Moreno-Gimenez *et al*] and the healing of open wounds [Marchini *et al*]. Extensive literature is available for those who wish to search for it. Most interestingly, retinoic acid has been reported in rosehip seed oil [Pareja *et al*.], though an analysis carried out at King's College London [Houghton] failed to find this material present in the samples analysed. A supplier's data sheet (not cited) also confirmed the presence of this compound as did a paper (not cited) from a researcher looking at different oils for varnish.

Hydration, skin occlusion, humectant, moisturising

There are two ways to protect the skin against moisture loss, the first is by using water soluble emollients such as glycerin (vegetable derived) and sorbitol (found in *Sorbus aucuparia* or Rowanberry), the second is by using oils to occlude the skin.

There are many hundreds of oils to choose from and a multiplicity of butters, fats and waxes. This has been covered extensively in the literature and will not be covered in this paper [Dweck, 1993].

Rubifacients

Many natural materials cause the skin to feel hot and deeply warmed, which has made them very useful in cases of sciatica and arthritic conditions. On a less severe condition, like muscle pain, aches, strains and sporting injuries, these materials are ideal.

As might be expected, many of the ingredients which taste hot and have pungent smells are most often the best choice for a rubefacient. Mustard (*Sinapsis alba*), Oil of Terpentine (from *Pinus* spp.), Capsicum Pepper (*Capsicum frutescens*) and Wintergreen (*Gaultheria procumbens*) are the most commonly employed. Another consideration might be Ginger or *Zingiber officinale*.

In *Capsicum frutescens* it is the capsaicin and related compounds that give the rubefaciency, whereas in *Gaultheria procumbens* it is the methyl salicylate that is responsible for the effect. In Ginger, it is probably the gingerols, shogaols and zingiberene. If all else fails one could always use it as a remedy for sea-sickness [Grontved].

Alcohol in high quantity (i.e. as in rubbing alcohol) is initially cold in its feeling as the alcohol evapourates from the surface of the skin, however, this is quickly replaced by a warm glow.

Milder effects can be obtained with members of the *Melaleuca* family, such as Tea Tree and Cajuput.

Skin whitening, hyperpigmentation

The abolition of hydroquinone in topical skin care products has caused an uproar in the Far East and in countries for whom this form of skin whitening product is almost a way of life in their cultural fashion. The alternatives are kojic acid, arbutin (from Bearberry or *Arctostaphylos uva-ursi*) and perhaps vitamin C (though the evidence is not entirely convincing).

In China and Japan, the traditional material is mulberry (*Morus* spp.), which contains a phenylflavonoid that is said to inhibit the action of tyrosinase (according to a supplier data sheet). Another supplier refers specifically to *Morus bombycis* (Kuwa or Sohakuhi locally) as the species that is used for skin whitening.

Varicose veins

Many of the materials have already been discussed for venous insufficiency. These include Horse Chestnut (*Aesculus hippocastanum*), Rosehipseed oil (*Rosa rubiginosa*) and Witch Hazel (*Hamamelis virginiana*). However, other materials also have a promising effect on this distressing condition, such as Cypress (*Cupressus sempervirens*)

[Lautier et Passebecq; Valnet; Tisserand] and Calendula (*Calendula officinalis*) [Bunney; BHP 1983; Wren, 1985; Evans, 1990; Back]

Calendula has been proved to have aromatic, anti-haemorrhagic, emmenagogue, styptic, antiseptic, anti-inflammatory, vulnerary, spasmolytic, diaphoretic, and cholagogue activities. Moreover, it has vasoprotective action and antibacterial activity, particularly against Staphylococcus. Triterpenic compounds (pure or their aqueous extract) are effective as spermatocides and antiblastocyst and abortion agents. It may be used for gastric and duodenal ulcer, amenorrhoea, dysmenorrhoea, epistaxis, and, topically for crural ulcer, varicose veins, haemorrhoids, anal eczema, proctitis, lymphoedema, inflamed cutaneous lesions, conjunctivitis [Morelli]. It is also excellent for bruises [Greenish; Wallis]

Conclusions

Plants do have a very profound effect on the skin, if used properly. It is tiresome to see herbal materials used incorrectly, downgraded by the bad marketing of inappropriate plants for a specific application.

The future is natural, the pharmaceutical industry has already committed enormous resources to the discovery of new natural plant drugs and is harvesting very rich and substantial rewards for their efforts.

There is no reason why the cosmetic and toiletry industry should not exploit what is a green, renewable and eco-friendly source and to use it with powerful scientific benefit.

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