Functional Botanicals - their chemistry and effects.

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[PP1] **Title slide 1**
Good Afternoon Ladies, Gentlemen and fellow scientists

[PP2] **Title slide 2**
Thank you for inviting me to speak at ICE-2000. I would particularly like to thank Nancy Allured for all of her help over the years. It might interest you to know that my first paper was published in Cosmetics and Toiletries in 1979. My kindest regards to Stanley and Betty-Lou for starting me on the road as an author.
The title of my paper today is Functional Botanicals - their chemistry and effects.

[PP3] **Functional Botanicals**
I hope that I can convince you that plants are fantastic chemical factories that can produce skin benefits as well as inspire wonderful pack copy and product ambience.

[PP4] **Introduction**
Plants are beautiful, there is not a consumer in the world that does not admire them. Many plants are tasty, and they contain vital ingredients that help us to sustain life. Not only have these chemicals been been used as foods, but they have been used in medicine and continue to be exploited and researched as new potent drugs. They are of great benefit to man.

[PP5] **The Natural Way Forward**
I hope in the next hour, that I can show you some new and exciting ideas that will give you a natural way forward.

[PP6] **Plant Criteria**
There are a sequence of points that should be followed in all uses of plant material, and I will use grape juice as my illustration.

- [Slide AR1] Who produced it (the Mondavi Winery)
- [Slide AR2] Where was it grown, Iceland is not renowned for its vintage wines
- [Slide P22] Which part is used for the benefit required - Imagine a wine made form vine roots or leaves
- Is the fresh or dried plant used? A wine made from raisins is called sherry!
- [Slide T15] When was it harvested? Imagine a wine fermented from immature sugarless grapes
- [Slide AR3] How was it harvested? Suppose that the grapes were slashed out together with the leaves and stems using a combine harvester, so that the extracted grape contained leaf and woody materials as well.
- [Slide T27] How was it processed? What sort of wine would you obtain by using a hydroglycolic extraction to replace the traditional method of pressing

- How much of the plant was used to produce the final product. It is an easy question in wine making, since 100% grape juice makes the wine, but suppose that the pressed juice was diluted with other solvent materials.
- How was it stored? Wine stored in open vats exposed to large volumes of air would quickly turn vinaigre (vinegary, like vinegar) - fine for fish and chips, but not for drinking.

[PP7] **Nature's Larder**
Whether it is exotic fruits, nuts, vegetables, grains, herbs, flowers or spices - nature's larder supplies us everything that we need in order to care for and treat the skin.

[PP8] **How do you see this plant?**
Some might say it is a novelty, an adventure for the child starting out in natural history. Others might have it as a talking point in their gardens, while some might grow it purely for the birds to feast on in the winter months. To a vegetarian it might be a source of protein-rich nutty seeds that can be roasted and salted like peanuts. To many it is a source of pure light cooking oil, while to me it is a rich emollient oil that can be used in emulsions instead of mineral oil. Perception is important and putting that message across to the consumer is vital, if your product is to be a success.

[PP9] **Consumer benefits from plants**
Plants can be used for their healing effect and I shall talk more about this later, they can be soothing and help to reduce inflammation, erythema (skin redness), pruritis (itching of the skin) and also be anti-phlogistic, that is to take the heat out of skin irritation. None of these effects will be achieved by the inclusion of a token quantity of plant material in your product. If you believe that 0.1% of a plant extract is going to do any good, then you probably believe in the fairies at the bottom of your garden.

[PP10] **Nature supplies all we need**
From a physical as opposed to physiological view, plants can be used to supply cleansers, moisturisers and emollients. They can provide antioxidants (free radical scavengers, anti-pollution claims), support the efficacy of your legal sunscreen or provide abrasive scrub particles for exfoliation products. They can provide excellent lubricants for massage oils and skin nutrients across a broad spectrum of chemicals ranging from vitamins to proteins.

[PP11] **Specific Skin Conditions**
This slide is the one that I normally use in my lecture to the postgraduate course in dermatology at the University of Wales, School of Medicine and it seemed appropriate to include the slide again in this presentation. By careful choice of the relevant plant one can target skin conditions that would be deemed "medical", clearly cosmetic law prohibits the treatment of medical conditions, but it does allow a product to protect the skin. So protect it against spots, inflammation, itching, blemishes, dryness, eczema, psoriasis, erythema, oedema, poor wound healing effects, pigment disorders, swelling, bruises and capillary effects. I make no apology for the way in which I will be presenting these slides,

unfortunately nature does not allow me to put each plant into a tidy category, since there are many overlapping properties.

[PP12] **Age spots, blemishes etc.**
Many plants are cited for age spots and related skin pigmentation problems. These include dandelion (*Taraxacum officinale*), elder (*Sambucus nigra*) [more effect from the flowers than the berries illustrated here], lemon (*Citrus limonum*) and strawberry (*Fragaria vesca*).

[PP13] **What is responsible for these effects?**
It might be the vitamin C (or ascorbic acid), it could be the tannins, but no one has yet made a scientific determination.

There are other plants that are worthy of investigation such as lovage (*Ligusticum levisticum*) and sundew or the Venus fly trap (*Drosera* species).

[PP14] **Natural Cleansers**
This is nature's weakest area! We use synthetic but naturally derived surfactants made from coconut or palm kernel fatty acids, and I guess that the alkyl poly glucosides (or APGs) and their esters are as natural as you can get at the time of speaking. In nature there are triterpenoid saponins, and it is interesting to notice that every continent has its own plant. For example, quillaja is basically South American, soapwort is indigenous to Europe, and soapnut is from India. They are all used to clean precious fabrics like ancient silks and tapestries.

Looking to the future, I expect to see the emergence of betaine from sugar beet (since it is an impurity that has to be removed from sugar crops).

[PP15] **Plants for acneic skin**
There are hundreds of possibilities, and if I have not mentioned the one that you know, then please accept my apologies. Tea Tree oil could be in almost every category, but I have included it here. There is good evidence that Hawthorn (*Crataegus monogyna*), Tepezcohuite (*Mimosa tenuiflora*) and AHAs (alpha hydroxy acids) could all have good effect for different reasons.

[PP16] **Anti-acne, spots and pimples**
Here is a picture of Hawthorn, and you will notice that soapwort (*Saponaria officinalis*), that I just mentioned as a source of natural surfactant has appeared here as well (it is a good antibacterial cleanser). Heartsease or wild pansy (*Viola tricolor*) has always been a great favourite of mine for a large range of problem skin conditions.

[PP17] **Materials for spots and pimples**
The presence of flavonoids, flavanols, triterpenoidal saponins and sesquiterpenes will all have beneficial effect on the skin flora and counter *propionobacterium acnes*.

[PP18] **Preservatives and antibacterials/antifungals**
This leads me quite neatly into the subject of natural preservatives. Many people are surprised to learn that the parabens are found in nature and so are classified as 'nature identical'. Likewise, benzyl alcohol and benzoic acid are found in balsamic resins. Sorbic acid is found in rowan berry or mountain ash and it would not be difficult to conceive of potassium sorbate as a derivative found naturally in nature.

However, I want to have a quick look at citrus fruits, especially at naringenin and hesperidin.

[PP19] **Skin stimulating, protecting, antibacterial**
We could look at grapefruit as a natural source of alpha hydroxy acids (AHAs), as an astringent, as an antibacterial or indeed as a fragrant essential oil. The diverse properties of grapefruit make it an exciting additive that can act as a skin stimulant, an exfoliator or simply for protection.

[PP20] **Citrus fruits contain a wealth of materials**
Here we see the structures of hesperidin, naringenin, one of the fragrant components limonene and of course that fruit AHA, which is citric acid.

[PP21] **Naringenin**
But do not go away with the idea that this material is only found in citrus fruits, you can find naringenin in hops (*Humulus lupulus*), liquorice (*Glycyrrhiza glabra*), in lime (not the citrus fruit!) also known as linden blossom (*Tilea europaea*) and even in shepherd's purse (*Capsella bursa-pastoris*).

[PP22] **Hesperidin**
This is the structure of hesperidin again, which is widely found in bitter orange or *Citrus aurantium amara*. The fruits seen here were photographed in Corfu.

[PP23] **Comparison of two compounds**
When you remove the glycoside side chain to get hesperitin, you will notice the similarity between that molecule and naringenin.

[PP24] **Plants for eczema**
There are many plants that are effective in conditions of eczema, especially where the condition is dry and desquamatous (flaking). I have picked my three favourites for this condition which are German chamomile, liquorice and heartsease.

[PP25] **Skin healing and soothing**
German chamomile or *Matricaria recutita* is renowned for its skin calming, anti-erythema (anti-redness), soothing and healing attributes. Its close relative Roman chamomile (*Anthemis nobilis*) has similar chemical composition and similar effects, but most of the literature is on the German.

[PP26] **Fascinating chemistry**
Both the essential oil and the aqueous extract are equally effective. In the oil it is the matricin (which converts into chamazulene during distillation) and the alpha bisabolol that have the major benefits. In critical CO_2 extraction the proportion of matricin is much higher and I believe this oil to be even more potent. The apigenin in the aqueous phase and its related glycoside are also strong anti-inflammatory agents. Apigenin is also available as Natural Yellow 2 - an approved food colour, I believe.

[PP27] **Anti-erythema or anti-redness**
This plant is a panacea for so many conditions that it is hard to know where to begin. It is of course Liquorice or *Glycyrrhiza glabra* or *Glycyrrhiza uralensis* (depending on which part of the world that you are harvesting it). The *uralensis* species is typically Chinese and the *glabra* is the most common variety found in Europe. They are almost interchangeable. It contains glycyrrhizic acid and another derivative called 18β-glycyrrhetinic acid amongst a great number of other fascinating molecules. This is a superb ingredient for sore, inflamed, red, itchy and swollen skin conditions. The more research carried out on this material, the greater the benefits that are discovered.

[PP28] **Plants with specific benefit I**
I now include a small section that contains plants, which have either been mimicked synthetically or have interesting molecules in their own right. They are all soothing, healing and skin calming. They are also very typically European, and materials that I use myself as a domestic remedy for all manner of skin ailments and injuries, because they are so effective. Comfrey or *Symphitum officinale* is a plant that grows all around me (at my home in Salisbury) in ditches, on embankments and in the hedgerow. It is one of nature's richest sources of allantoin, a vulnerary or wound healing agent, that is documented in Merck and Martindale (to name but a few sources).

[PP29] **Plants with specific benefit II**
My wife says that I am crazy, but I always leave a small patch in my lawn for Ribwort Plantain (*Plantago lanceolata*) and Common Plantain (*Plantago major*) to grow and prosper. It is soothing for insect bites, will stop bleeding from minor cuts and abrasions, and is excellent for a whole host of irritating skin problems. It contains a lot of mucilage, which in itself is very soothing, but also present is this material called aucubin, which is found in many other plant species (many of which have similar soothing properties). A strong infusion of plantain will also be of comforting benefit in shingles.

[PP30] **Plants with specific benefit III**
This plant can be grown for its foliage, its flowers and for its benefits. Sage or *Salvia officinalis* is one of nature's most useful plants. It tastes great in sage and onion stuffing and the high tannin content makes it ideal as refreshing tea. This tea can also be used topically as an astringent to tone up sluggish skin, as a soothing compress on inflamed or irritated skin and as a foot bath for weary feet. The strong tea can be used as a gargle for mouth ulcers and other oral infections, while the oil is used in aromatherapy.

[PP31] **Anti-erythema & anti-radiation**
You could write a book about my next member of the Lily family, and I am pleased to report that the decennial review of this plant by Dr. Tom Reynolds from Kew Gardens and Dweck has now been published in the Journal of Ethnopharmacy (October / November issue 1999). This gel from this plant is soothing, cooling and wonderful on erythema and sore skin, but you have to use it at 50% w/w or more in your formulae to see any real benefit.

I have seen it used successfully for the protection of the skin against UV-erythema, and against the effects of radiotherapy. If the plant is used 2-3 days prior to treatment (applied twice a day) it has a prophylactic effect against the effects of that treatment. We scientists argue incessantly about which components are responsible for this effect, and I am now firmly of the opinion that it is the mannose-6-phoshate in combination with trace amounts of aloin, aloe emodin and other trace components. The way in which the plant is harvested, processed and stored is of vital importance to the effective activity of the plant.

[PP32] **Some more chemistry!**
As this slide shows, the chemistry is complex, varied and, sadly, still not complete. One author suggested that Aloectin B might be responsible, but to date the structure has not been fully elucidated.

[PP33] **Anti-erythema, healing and anti-oedema**
One of my predictions for the new millennium is that this plant will gain better recognition and become more popular as a component in skin care products. Gotu kola or *Centella asiatica* is a fairly boring looking plant and even getting a decent photograph or digi-image was not easy! Apologies for the picture apart, this plant contains a fascinating molecule in the form of asiaticoside, which as you can see from the structure has a fascinating steroidal structure. It has exceptional properties on the skin, being a traditional remedy for all manner of skin diseases, especially those that include irritation, erythema, swelling, poor healing characteristics and pain.

[PP34] **Free-radical scavenger, anti-inflammatory & anti-oedema**
If my previous slide was typical for Malaysia, then this next plant, the Maiden Hair tree or *Ginkgo biloba* is typical and reminiscent of China. In fact this tree was one of the few that survived the Great Ice Age, and is believed to live for as long as 1,000 years.

Its claim to fame has come as a dietary supplement for age-related disorders such as circulatory problems and failing memory, but like Gotu kola, I am prepared to predict that this plant will have increasing use for its free-radical and soothing effects when applied topically. The structure of the ginkgolides is extraordinary and I can find no structures in any other plant that can compete with them for this large amalgamation of pentacyclic ring structures.

[PP35] **Antioxidants**
I do not want to burden you with huge lists of plants and there is not time to cover each plant individually or to look at all the chemical structures involved. However, when it comes to free radical scavengers and antioxidant, nature has a huge arsenal of possible

candidates, all with different reasons for their success in protecting themselves against the effects of UV and oxidation. Green tea, rice bran, *Polygonum* species, Witch hazel, various medicinal rhubarbs, and the strawberry tree are some examples.

[PP36] **Skin protection**
I will take just one of these materials as an example, but as I said, we could have examined each and every material (mentioned in the last slide) systematically had time permitted.

Green tea or *Thea viridis* (sometimes called *Camellia sinensis*) is antioxidant, astringent, anti-pollution (a new term in our industry), anti-stress (another new word from our marketing colleagues) and anti-ageing.

[PP37] **Green tea (*Thea sinensis*)**
It is more than likely the flavonoid like structures that are responsible for this scientifically proven action. Epicatechin and epigallocatechin-3-gallate are the prime ingredients in green tea.

[PP38] **Immune stimulant**
I am going to do no more than mention Purple Coneflower or *Echinacea purpurea* as an immune stimulant. This is another dietary supplement for the protection against influenza and infection that has the fastest growing sales in any health food supplement category. We are beginning to see increasing evidence that the plant has benefits when applied topically, namely as a healing agent, for skin soothing, as an anti-inflammatory and antioxidant. It is another prediction for this year.

[PP39] **Varicose veins, haemorrhoids, inhibits oedema, leg ulcers**
The humble Horse Chestnut or *Aesculus hippocastanum* is a powerful plant, that you will have probably been more likely to use as a hair care additive than anything else. It is, however, a powerful stimulant for blood circulation and particularly of the peripheral blood vessels. Aescin or escin is very useful for cases of oedema, cellulite and varicose veins. There is also good evidence that where circulation is bad, especially in the aged, where varicose veins and poor healing leg ulcers can become a problem, that this material is of great benefit.

[PP40] **Anti-oedema plants I**
While I am discussing the topic of poor circulation and oedema, it is well to remember that this situation can rapidly develop into cellulite or cellulitis. Butcher's Broom or *Ruscus aculeatus* is a plant that has enjoyed great success as a treatment for this condition, especially where the level of ruscogenin is significant. I am not saying that diet, exercise and massage are not contributory to the cure, because these are vitally important to staving off cellulite, however, ruscogenin will help when applied topically.

[PP41] **Anti-oedema plants II**
If Butcher's Broom is not readily available, then Ivy or *Hedera helix* is a good 'next bet' and the hederagenin content will play an important part in determining the success of the preparation.

[PP42] **Comparison of two anti-cellulite compounds**
The first thing to notice when one looks at these two materials is the close resemblance of ruscogenin to diosgenin (which itself was a precursor to many cortico-steroid preparations and even female contraceptives). The second thing to notice is that hederagenin has a steroidal structure. Steroids by their nature are anti-inflammatory, so it is easy to see why these materials should have an effect, even from a theoretical point of view.

[PP43] **Cellasene**
Cellasene was the first oral herbal preparation to take the market by storm, and you will notice that Sweet Melilot or *Melilotus officinalis* is the active ingredient here. The inclusion of *Ginkgo biloba* is for the improvement in circulation effects, *Fucus vesiculosis* is often cited for cellulite, but I have yet to be entirely convinced by the evidence or the chemistry.

[PP44] **Scar healing (cicatrising)**
Rosa rubiginosa or rosehip seed is my favourite oil of all time, it is the Pavarotti of the natural oils and it sings beautiful effects in topical products. I have seen skin blemishes lighten, I have seen necrotic tissue soften, stubborn wounds heal and obstinate scars improve. I do not know why this should be, it is not only the GLA (*gamma* linolenic acid) nor is it the linoleic acid that gives this effect. However, two references mention the presence of retinoic acid and this would be significant. However, I have to say that a study carried out a few years ago did not find this material in a number of different oil samples that were tested. At the moment, my hopes are (scientifically) just wishful thinking.

[PP46] **Skin and hair care**
I put in Hibiscus (*Hibiscus rosa-sinensis*) because I like it and there have been so many cosmetic raw materials that have appeared with it recently. Apart from being a source of AHAs, it has ethnobotanical use as an antiseptic, emollient, astringent, cooling and antipruritic agent. It also has considerable value in hair care. I am not going to cover the chemistry, because I have not managed to complete my own survey of the ingredients in time for this lecture.

[PP47] **Varicose veins and capillary damage**
I touched on this subject a few minutes ago with horse chestnut or *Aesculus hippocastanum*, but there are other materials that are excellent for problems like thread vein or broken capillaries and for more severe conditions like varicose veins. These would include materials like Cypress or *Cupressus sempervirens* (an essential oil), Witch Hazel or *Hamamelis virginiana* and Calendula or *Calendual officinalis*.

[PP48] **Soothing, anti-inflammatory, mildly astringent**
This is witch hazel, immensely complex in its composition, but containing complex tannins like hamamelitannin and unusual molecules like hamamelose. This is the best cure for piles or haemorrhoids and is licensed for that purpose.

[PP49] **Anti-inflammatory, for varicose veins, eczema, haemorrhoids, cutaneous lesions, bruises, boils etc.**
Look at the benefits from Calendula, what an amazing plant, to every herbalist it is one of the most widely used plants in the repertoire. It is hardly surprising, when you look at the complexity of the phytochemistry, to be unable to say with any certainty if there is any individual compound that is responsible for these effects. It has caryophyllene (which is quite common in the plant world), cadinene and β-sitosterol (which is also no stranger to the plant world). Who knows! It is probably a synergistic reaction of all of these materials that gives Calendula its wonderful properties.

[PP50] **Antioxidant, antibacterial**
Those of you with an exceptional memory, will remember that we had a section on antibacterials on slide 18! However, we have not had a specific section on antioxidants, so I decided to include one here. We all know about vitamin E, and most of us know that β-carotene or provitamin A (from Carrots, *Daucus carota*) have good antioxidant effects. Many might not appreciate that tomatoes or *Lycopersicon esculentum* contains a material called lycopene (an *alpha*-carotene) which is ten times more potent than β-carotene. It also contains a material called tomatidine, which is a useful natural preservative.

Tomatoes are said to reduce sebum production and clearly would be a useful addition to suncare products.

[PP51] **Plants for psoriasis**
This is a very difficult topic and I cannot do it justice in this lecture because of time constraints. Banana, chickweed, cleavers, meadowsweet, willow, Oregon grape and burdock are just a few of the plants cited for psoriasis. There are dozens more, which I could have mentioned.

[PP52] **Acne, alopoecia, suppurations, eczema and psoriasis**
Burdock or *Arctium lappa* is a material that Dr. Chris Lovell and I examined a few years ago in a blind monadic cross-over study. The results were sadly not significant. However, with more data and more references, I am now convinced that we used the wrong part of the plant. Remember what I said earlier about getting that choice right! Inulin is an important starch like material that would certainly help in cases of dry desquamatous (flaking) skin conditions, but one also needs to have a good level of lappaols A and B.

[PP53] **Skin whitening**
If I had a dollar for every time that I was asked about skin whitening plants I would have retired months ago and would not have needed to work for my living. Clearly, hydroquinone is now out of our repertoire, it is a suspected carcinogen and no longer acceptable in topical products.

Kojic acid, a product of mushrooms is widely cited in Japan, but apparently not as effective as arbutin. This is hardly surprising, since arbutin is a substituted hydroquinone, which as we all know is a prohibited skin whitening agent! We obtain this arbutin from Bearberry or *Arctostaphylos uva ursi*.

[PP54] **Skin whitening, astringent, antiseptic**
These are some nice pictures of uva ursi or bearberry and you will notice that in addition to arbutin one of the components is ursolic acid. Why is it that arbutin does not irritate the skin like hydroquinone? That is a reasonable question which I have asked myself.

[PP55] **Ursolic acid**
Ursolic acid is found in the waxy coatings of apples and also found in plants like Self Heal or *Prunella vulgaris*, Rosemary and Thyme. All of these plants contain ursolic acid and all of these plants have anti-inflammatory activity. You can now see why it is difficult to follow a logical progression through a plant lecture like this. One is easily led astray by the clever chemistry.

[PP56] **Burn debridement, necrotic tissue, anti-inflammatory, anti-oedema**
An illogical place to put pineapple and papaya, but I wanted to pick up on the other natural products that work well on cellulite conditions. Proteolytic enzymes are starting to fascinate surgeons and dermatologists. What was good at tenderising a tough joint of meat is also good for tenderising human skin and even capable of dissolving dead necrotic tissue. Bromelain and papaine are powerful and certainly capable of mobilising adipose tissue from a position of stasis.

[PP57] **Astringent, toning**
Still on the subject of stimulating sluggish adipose tissue and incumbent cellulite. I thought that it was useful to mention caffeine (normally from caffeine), but in this case I have chosen Guarana or Zoom (*Paullinia cupana*) as the source, simply because it is making good press in the skin care industry.

[PP58] **Natural Oils I**
And talking of zoom, I am now going to quickly zoom through the rest of my lecture, which I have included for completeness. We have talked about some fairly dynamic and active plant materials, but we should not lose track of the simple but effective moisturisers like coconut, avocado, wheat germ oil, arachis oil, apricot kernel oil, jojoba (nature's liquid wax) .....

[PP59] **Natural Oils II**
.....blackcurrant seed oil, borage seed oil (or starflower) with their high GLA contents, Brazil nut oil for its taste of the rain forest, camellia oil for its oriental flavour, castor oil for its powerful protective properties, cotton seed oil for its image of purity, evening primrose oil for its GLA and imagery, grapeseed oil for the great interest that most vine products are having.

[PP60] **Moisturising, protective and retains skin hydration**
Here we have pictures of two of the traditional GLA containing plants.

[PP61] **Natural fats and butters**
Sometimes we want a material that will rub into the skin and melt like butter, nature provides us with cocoa butter, illipe butter, coconut butter, shea butter and mango butter. I often wonder why it is that most of the butters are from the African continent.

[PP62] **Natural Waxes I**
Nature is rich in waxes, but sadly the number produced seems to have fallen since the late 1800s. We are still left with some classics like carnauba, beeswax, lanolin wax and candelilla, and some new waxes like winter melon, sunflower and bayberry have made an appearance. Incidentally, the Latin name *cerifera* means wax maker. I have included jojoba because (as I said earlier) it is a liquid wax.

[PP63] **Natural Waxes II**
There are now a number of rather exotic waxes that have come onto the market, things like lavender, jasmine and orange, which are part of the sticky mess left in the distillation vessel once the essential oil has been extracted. A similar wax is left after the critical CO_2 extraction of hop oil. Most of the palms have solid fractions that could be termed waxes, like coconut, babassu and palm. There is also a very crisp wax from rice bran and a softish wax that can be obtained from avocado.

[PP64] **Natural Emulsifiers**
We briefly mentioned beeswax, and this could be reacted with borax to form a water in oil emulsion. It is not very sophisticated, but it is well tried and tested - think of Brylcream from the old days!

If we could produce caustic soda or potash naturally, say from producing ash by burning something like water hyacinth (which is so plentiful as to be a nuisance), or from Royal Fern or Prickly Chaff Flower, then we could saponify fatty acids to make soap.

You could use lecithin from soya or you could use casseine from milk. In theory you could use betaine from beets to emulsify water and oil together. There are a lot of "nearly natural" emulsifiers around, most of them ethoxylated, but I did come across rapeseed sorbitol, which is the best material I have seen so far this millennium.

[PP65] **Natural Moisturisers**
Glycerine from vegetable sources is popular, sorbitol from Mountain Ash or Rowanberry is not so popular these days, probably because it is thought too sticky. However, there is another way to produce water soluble moisturisers and that is to use pulped fresh materials like cucumber, avocado, banana and strawberries. High levels of Aloe vera will always have good effect, and the use of oats for dry skin conditions is also well respected.

[PP66] **Thickeners**
Nature is abundant in cellulose and polysaccharides both on land and sea.

[PP67] **Chelating agents**
One needs a chelating agent to complex out the trace elements that can discolour and spoil your product, you also need them to help break down the cell membrane of spoilage organisms. Rice Bran is a source of phytic acid, a cyclic hexaphosphate, which is a powerful and respected chelating agent that has found use in the food industry.

[PP68] **Sunscreen agents**
Many plants have UV absorbance spectra that will contribute to the sun protective properties of a sunscreen lotion or cream. However, this is a topic of such enormity that I am going to exclude it from my lecture today.

[PP69] **Skin Darkening**
Not everyone wants to have lighter skin, those with the skin condition vitiligo would love to make an albino skin patch darker. In our industry we avoid the psoralens like the plague, compounds like bergapten in bergamot oil. These materials sensitise the skin to sunlight, and it is not until one sits in the sun that this phototoxic reaction manifests itself. The result is powerful and repetitive skin darkening in the presence of UV light. The reaction can persist for life.

Once again there are numerous plants cited, but Bishop's Weed and Giant Hogweed are quite high up the list. St. John's wort is a much safer, but a less effective remedy.

[PP70] **Fake Tanning**
Nature has no direct answer to DHA or Di-hydroxyAcetone, so if you want to have a tan after the sun has gone down, then you will have to stain your skin with walnut or henna. Let me tell you that these are powerful dyes and they will probably last as long, if not longer than DHA on the skin.

[PP71] **Fragrance**
When I first joined this industry thirty years ago, I was told that a 100% natural fragrance was impossible to produce - it is amazing how perseverance and a change in consumers' perceptions can achieve results. Aromatherapy and natural fragrance blends are now commonplace. Not only can an essential oil mask base odour, it can deliver psychosomatic benefits, provide skin attributes and even contribute to the preservation of your product.

[PP72] **Essential Oils**
I am not going to begin to attempt to list the hundred or more commonly used essential oils, this is just a list of some of my favourites.

[PP73] **Natural alcohol**
We need alcohol for its solvent properties to cleanse the skin of excess oils, fats and sebum. We also need it for its astringent and antibacterial effects. Alcohol can be obtained by natural fermentation or it can be obtained as witch hazel, which is about 7% alcohol.

[PP74] **Seaweeds**
I have concentrated on the terrestrial plant forms, but do not forget that the sea has a wonderful offering to our palette of natural ingredients. Many of the things that I have discussed today can be achieved using marine extracts.

[PP75] **Conclusion**
My conclusion is simple and I care little for what your marketing department may think or say.

Used at significant levels, plants are meaningful to a body
Used at insignificant levels, they are meaningless to anybody.

[PP76] **Thank you!**
Thank you for inviting me to this wonderful country, I always love coming - and thank you for listening to me with such patience. I will happily take questions on any aspect of botanicals, whether I have mentioned the plant in this lecture or not.