1999 POST GRADUATE COURSE IN COSMETICS & TOILETRIES'

BOTANICALS IN COSMETICS & TOILETRIES

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Introduction

[Slide G13] If you think that 0.05% of a dilute botanical extract is sufficient to make claims, then think again. For there to be any chance of an effect, you have to use at least 2% of the fresh plant equivalent and levels as high as 5% are probably more realistic.

From the very beginnings of time Man has been using botanical materials for the beautification and care of the skin. In the next few slides you will see that the use of cosmetics and toiletries goes back to the very cradle of our civilisation.

[Slide G22/21/23/24] Here we have pictures from the tomb of Tutankhamen showing the relief on his sarcophagus screen and on his thrown, where the young Queen Ankhesenamen is annointing his collar

[Slide Q36/35/39/40}In these slides you can see the use of unguent cones as a means of perfuming

[Slide L50] and here you can see the use of colour cosmetics to enhance the beauty of this Egyptian Queen.

I am not saying that everything that the Egyptians used on their skins was beneficial, indeed, many of the materials were posionous and some were even carcinogenic.

[Slide L48] Nor was their art of perfumery primitive, as this recipe for Kyphi (an hypnotic incense shows)

[Slide Q21]

A natural skin care range

Today we are going to do some theoretical work on products for very dry and desquamatous skin. The problems for this customer would be skin erythema (redness), pruritus (itching), desquamation (flaking) and occasional slight oedema (swelling). I will consider a facial wash, a moisturiser and a special toner, mainly so that we can explore the natural options for the emulsifier system, the preservative, perfume, the water and oil soluble excipients and any other special requirements such as a chelating agent, colour and thickeners.

Let me say at the outset, that the goal of achieving a 100% natural product is not achievable with the raw materials currently available “off the shelf”, and we will also have to use materials that are either nature identical or naturally derived in order to fully achieve our objectives. We may also decide that cost and inefficiency will lead us to the conclusion that synthetic compromises must be made.

Before I can start to discuss this topic it is important to lay down the ground rules.

Definitions

We must first define by what we mean by natural, and though this definition is not legally defined, an undisputed description would be "any material that is harvested, mined or collected, and which may have subsequently been washed, decolourised, distilled, fractionated, ground, milled, separated or concentrated in order to leave a chemical or chemicals that would be available and detectable in the original source material". As an additional consideration I would include "the modification of natural material by the action of micro-organisms, enzymes or yeasts in order to modify or increase the yield of material by this process."

[Slide Q15] The classic example is the production of alcohol by the action of yeast on sugar.

The definition of "naturally derived" would be "the use of a natural raw material as the starting point in a chemical process to produce a new chemical or chemicals that in themselves may not be available in nature or in the starting material".

[Slide U40] An example of this would be the sulphation and ethoxylation of fatty acids obtained from coconut to produce sodium lauryl ether sulphate (CTFA Sodium laureth sulfate).

The definition of "nature identical" is "a substance that has been produced synthetically, not usually from a natural starting material, in order to produce a material that is identical to that naturally occurring in nature". An example of this would be Vitamin E from wheat as opposed to that made from a petrochemical starting point.

[Slide Z45]Another example would be the synthesis of α-bisabolol (a component naturally occurring in chamomile). The nature identical materials are considerably cheaper, and often occur as racemic mixtures, whereas the natural form is the single, optically active variety.

Sources of information

[Slide AO49] We must obtain data for all these natural materials for our PIP (Product of Information Package). In many cases the supplier data sheets are not reliable, and one cannot always trust what they say.

[Slide G20] The use of Pharmacopoeias, Herbal Medicinal texts, Herbal Pharmacopoeias, Folk lore, Ethnobotany will provide a great deal of data, as will searching of data bases such as EMBase, and Medline.

The level of plant material to be used

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 renouned 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 quickle turn vinaigre - fine for fish and chips, but not for drinking.

[Slide T8 spacer]

Thus, be sure that you know which part of the plant is used for the purpose that you require, i.e. the leaf, flower, whole herb, stems, roots, rhizomes, fruits (seeds), the bark or the sap. Find out whether it is the aqueous or oil soluble fractions that have the benefical ingredients. Then find out how much of the plant needs to be used in order to achieve the effect that you require. It is of no use at all to use an extract of unknown concentration and you should make it your practice to work in fresh plant equivalents. Thus if a supplier uses one part of fresh plant to one part of solvent by weight, then you may assume that when you use one gramme of that extract it will contain at least half a gramme of the plant. If the extract was made from dried plant material, then as a rule of thumb, multiply your figure by a factor of eight.

Aesthetics

Before you can do anything, establish the following:-

- How much money can you spend on the formula?
- What are the claims that you want to make?
- [Slide Q37] Can you afford the grandiose plans conceived by your marketing department on the budget that they have allocated?

Considerable costs can be saved by compromise, the more naturals you take out, the more money you will save, the more stable the product will become! Synthetics are much easier to use than botanicals.

Now that we have established some basic rules and we can begin to tackle the subject matter.

[Slide T9 spacer]

TYPICAL NATURAL RAW MATERIALS USED IN COSMETICS AND TOILETRIES

1. Formulation of creams and emulsions

The first consideration in an emulsion product would be the excipients, i.e. the oils and the waxes.

Natural waxes
There are a multitude to chooose from:-

Carnauba or *Copernicia cerifera*
This is a high melting point wax most commonly found in lipsticks, but it can be emulsified into emulsions when used in combination with lower melting point waxes as a co-solvent.

Winter Melon or *Benincasa cerifera*
Not available in commerce

[Slide AQ5] Sunflower seed wax

[Slide S45] Bayberry or *Myrica cerifera*
Now available in commerce

Candelilla or *Pedilanthus pavonis* Boiss.
A wax similar to carnauba in all respects, but of lower melting point.

Beeswax or *Cera alba*
Widely available and extremely useful in emulsions. Can be used with borax to form a beeswax/borax water-in-oil emulsion, some other mineral salts will also work as an emulsifier in place of borax.

Lanolin Wax
Produced as a fraction of lanolin from the higher melting point components, is widely available in commerce.

[Slide AC39/AC40] Jojoba or *Simmondsia chinensis*
A fascinating material, which theoretically one would expect to be a solid wax, but in reality is a liquid wax. Well known and respected, widely available commercially.

[Slide A27] Lavender Wax or *Lavandula angustifolia*
[Slide AK49] Jasmine Wax or *Jasminium officinale*
[Slide K9] Orange Wax or *Citrus aurantium*

These three waxes are available commercially, but are very expensive. They are produced from the sludge left behind after distillation of the essential oils from the flowers of these plants.

[Slide Z2] Hops or *Humulus lupulus*
This is not commercially available at the moment, but is part of the by-product thrown away by the hop oil producers.

[Slide U41] Coconut Wax or *Cocos nucifera*
Widely available as coconut butter and as the wax.

Babassu Palm Fat or *Orbygnia martiana*
Oil Palm or *Elaeis guineensis*
I have not been able to find good commercial sources of these materials.

[Slide BC31] Rice Bran Wax or *Oryza sativa*
A lovely white wax, that has excellent properties and is just about commercially available.

[Slide U37] Avocado Wax or *Persea americana*
Another wax that is now becoming commercially available.

Natural oils

There are so many natural oils available that we a spoilt for choice!
Coconut or *Cocos nucifera*
Avocado or *Persea americana*
Wheat germ oil or *Triticum aestium*
Jojoba or *Buxus chinensis* (formerly *Simondsia chinensis*)
[Slide AJ6/AJ11] Sweet Almond oil or *Prumus dulcis*
Arachis oil or *Arachis hypogaea*
Apricot kernel oil or *Prunus armeniaca*
[Slide AC7] Blackcurrant seed oil or *Ribes nigrum*
[Slide AD23] Borage seed oil or *Borago officinalis*
[Slide D12] Brazil nut oil or *Bertholettia excelsa*
[Slide U36] Camellia oil or *Thea sinensis*
[Slide P27] Castor oil or *Ricinus communis*
[Slide Z32] Cotton seed oil or *Gossypium herbaceum*
[Slide B13] Evening Primrose seed oil or *Oenothera biennis*
Grapeseed oil or *Vitis vinifera*

This list is by no means conclusive and I am sure that you could name many more.

[Slide T10 spacer]

Natural fats
There exists in nature an intermediate material to waxes and oils and these are the butters, which by virtue of their blends of different molecular weight fatty materials are soft, spreadable pastes at ambient temperatures.

Cocoa butter or *Theobroma cacao*
Illipe butter (Borneo Tallow) or *Shorea stenoptera*
Coconut butter or *Cocos nucifera*
Shea Butter or *Butyrospermum parkii*

[Slide AA43] Mango Butter or *Mangifera indica*
Recently available commercially, this is a sweet and clean smelling buttery wax.

These are widely available, often have a distinctive odour which may be a problem if used at high levels in the product.

Moisturising agents of the aqueous phase

We now turn our attention to those materials that will act as humectants. Normally we would immediately think of sodium PCA, propylene glycol or other glycols. It is on the idea of glycols that we could turn to glycerine, which is available from natural vegetable sources.

Another naturally occurring material is sorbitol, which is a sugar isomeric with mannitol and dulcitol.

[Slide X35] It is most commonly found in ripe mountain ash or rowan berries, the name sorbitol is derived from its Latin name *Sorbus aucuparia*, cherries, plums, pears and apples etc.

It might be, that we would prefer to use ground up fruits such as:-
Cucumber or *Cucumis sativus*
[Slide O24] Avocado or *Persea americana*
[Slide M18/Z29] Banana or *Musa paradisica*
Oatmeal or *Avena sativa*
[Slide B1] Strawberries or *Fragaria vesca*

[Slide AD25] Or we might prefer to use the leaf sap of a plant like Aloe vera or *Aloe barbadensis* Miller.

[Slide T11 spacer]

Emulsifiers

We hit our first major problems when we come to consider what to use as an emulsifier, since the availability of effective materials, though technically feasible, in commercial reality is almost impossible.

The use of beeswax and borax has already been mentioned, but where do we find replacements for our normal pallette of materials to produce oil-in-water emulsions?

For anionic, I can think of none, unless we can produce our own natural soap, i.e. by reacting natural fatty acids with caustic soda or potash. However, most sodium and potassium hydroxide is made synthtically and there is no commercial source that I know of, where the material has been extracted from wood ashes. The extraction of caustic potash from wood ash is probably one of the most ancient ethnobotanic traditions (e.g. Quiapo or *Pistia stratiotes* one of the Araceae family, Water Hyacinth or *Eichhornia crassipes* one of the Pontederiaceae family,
[Slide AK39] the Royal fern or *Osmunda regalis*, the fruit of the Prickly Chaff-flower or *Achyranthes aspera* of the Ameranthaceae family.

Amongst the cationic emulsifiers are lecithin (obtained from soya) and casseine (which can be obtained from milk). This is a promising avenue of research, though the types of emulsion obtained are limited in their scope.

Nature does not appear to have nonionic emulsifiers, though I recently discovered a source of plant derived betaine from
[Slide AL44] sugar beet or *Beta vulgairs*, which would have amphoteric properties.

Thickeners

Nature is a prolific provider of thickeners and though none of them are as versatile as our trusty friend the carbomer, one can produce every viscosity increase from a slight thickening to a gel for a face mask.

[Slide AR12] One of the most recent to hit the commercial market is a branched polysaccharide (arabinogalactan) which has been obtained from larch or *Larix occidentalis*, the properties are said to be similar to guar gum.

Most cellulose gums are naturally derived as an unwanted part of the wood pulp process to produce paper.

There are also a host of natural gums, which include
[Slide S21] Locust bean gum from the carob seed or *Ceratonia siliqua*,
Xanthan gum which is an exocellular biopolysaccharide obtained from a fermentation of *Xanthomonas campestris*

[Slide AC16] Alginate and carragheenan gums from various seaweeds
guar gum which is obtained from the Indian Cluster bean or *Cyamopsis tetragonolobus*

Other gums include: Karaya or Indian Tragacanth or *Sterculia villosa*, Tragacanth from *Astragalus gummifer*, and

[Slide AI17] Gum Arabic from *Acacia senegal*

Preservatives

The subject of natural preservatives is one on which I have lectured on many occasions, and I am afraid to say that it is so complex, that it is a subject in its own right. I can only summarise this topic by saying that there are no commercial sources of plant derived natural preservatives, but there is a mimic of a preservative technique used in nature, which is Myavert C.

Benzoic acid and benzyl alcohol both occur in plants and are also on the permitted list of preservatives, thus may be used as 'nature identical' preservatives.
[Slide Q42] In a similar vein, sorbic acid occurs in nature, particularly in the rowan berry and so if one could react that with potassium hydroxide to form potassium sorbate, then one would have a naturally derived preservative.

[Slide AA24] Another commercially available preservative is derived from grapefruit seed, and though the active material was never identified in the literature, it was almost certainly naringenin, a molecule that occurs widely in *Citrus* spp., and is closely related to hesperidin, which also occurs widely in plant materials.

Antioxidant

[Slide U5] Antioxidants are also an important part of our claim strategy and though the most publicised antioxidant is vitamin E, which occurs quite abundantly in nature, especially in wheatgerm oil, it is of course, mostly available as a synthetically derived form. So nature identical is your best bet!

Chelating agent

[Slide U4] The most commonly used chelating agent would be of the ethylene diamine tetraacetic acid form or EDTA and its sodium salts. In nature, phytic acid (from Rice bran) is also a very good chelating agent.

Sunscreens

I had intended to mention natural sunscreens, but not only does time not permit a detailed discussion, but they are not on the list of officially permitted sunscreens, and so I decided to omit this topic from my talk.

Perfume

The product will need to be perfumed and here one should concentrate on the use of essential oils. There are literally hundreds of fragrant materials derived from nature, most of them are extremely expensive and on their own seem rather crude to the nose of the consumer who expects a sophisticated smell to their product.

[Slide H42] Rose
[Slide J15] Lemon
Grapefruit or
[Slide AK47] Geranium

Lavender
[Slide AQ43] Neroli
[Slide BC32] Lemongrass or *Cymbopogon citratus*
[Slide BC27] Lemon verbena or *Alloysia citriodora*
[Slide BC36] Myrrh or *Commiphora myrrha*
[Slide BC33] Patchouli or *Pogostemon patchouli*

2. Formulation of toner
The toner requires a few extra details to be considered.
[Slide Q14] Natural fermentation alcohol is widely available, but will require the customs and excise duty to be paid on it, nor will the customs and excise officer allow you to use quassia as a denaturant (which used to be one of the natural denaturants allowed), to provide a tax exemption.

[Slide BB6] Of course, you may want to consider Witch Hazel or *Hamamelis virginiana* as a source of natural alcohol, and incidentally as a source of some very beneficial properties. The benefits include anti-inflammatory, healing and antipruritic.

Solubilisers

Finally, you will have the problem of how to solubilise your perfume into the final product. Here I am stuck! You could use very high alcohol levels or alternatively use essential oils from which the alcohol soluble components have been extracted. These are limited in their number and also tend to be rather delicate in their performance. They are also very expensive!

I wondered whether natural saponins might be helpful, here we have
[Slide BD37] Soapwort or *Saponaria officinalis* and
[Slide AI33/AI15] Indian Soapnut or *Sapindus indica* but since it is not possible to obtain pure triterpenoidal saponins commercially and because these saponins are haemolytic in nature at high concentrations, I drew a blank. My recommendation would be to go for a toning milk or alternatively allow the product to be slightly hazy.

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Beneficial additives

We said at the beginning that we were looking for plants that would have anti-inflammatory, soothing and healing properties on the skin. There are a vast number to choose from and again I must apologise for not being able to cover this is in any great detail in the one hour allocated to my talk.

Seaweeds

The growth of thallasotherapy and "From the Sea" type products warrants a quick mention, since there a large and impressive number of marine derivatives now available on the market. These materials provide an outstanding number of benefits, from simple moisturising to increasing fibroblast activity and free radical scavenging effects.

[Slide AR15] Sea Lettuce or *Ulva lactuca*
[Slide AR16] Dulce or *Palmaria palmata*
[Slide AR17] Coral Seaweed or *Corallina officinalis*
[Slide AR18] Bladderwrack or *Fucus vesiculosis*
[Slide AR19] Kelp or *Laminaria digitata*

I have already mentioned the importance of adding enough plant material to be of benefit, now I would qualify that remark still further by adding the requirement of firstly knowing what is the active material in your plant responsible for the effect that you are seeking and secondly ensuring that the plant extract that you buy has this chemical standardised in that extract.

Thus if we were looking at
[Slide AH38] Comfrey or *Symphitum officinale*, then we should be concerned about the level of allantoin that is contained within the extract. Allantoin is excellent for wounds and ulcers and is defined in Merck as vulnerary or wound healing.

[Slide AR33] Allantoin

[Slide H31] If we were looking at the Common Plantain or *Plantago lanceolata*, then we should concentrate perhaps on the level of aucubin, which is soothing, anti-inflammatory and anti-erythema.

[Slide AR32] Aucubin

[Slide B27] With Sage or *Salvia officinalis*, we should be concerned with the level of tannin present in the extract, which would be responsible for the skin firming effects and astringency that we might want in our toner.

[Slide AR31] Tannin

[Slide AD1] With German Chamomile or *Matricaria recutita*, we should be concerned with whether we are using an aqueous extract or the essential oil, since in the aqueous extract we are looking at the flavonoid level of apigenin and apigenin-7-glucoside, whereas in the oil we could either be concerned with the α-bisabolol content, or indeed, with the chamazule content, since both entities have beneficial effects. Those effects are soothing, healing and anti-inflammatory.

[Slide AR27] Bisabolol
[Slide AR28] Apigenin
[Slide AR29] Chamazulene

[Slide AL20] In the Aloe vera or *Aloe barbadensis* Miller, we should be interested in the barbaloin content (i.e. not too much) and also in the mannose and mannose-6-phosphate levels. I wish you luck, because nobody who sells aloe vera seems to have the slightest interest in the chemistry of what they sell! The effects are to stimulate fibroblast activity and improve the rate of wound healing.

[Slide AR24] Barbaloin
[Slide AR25] other ingredients

[Slide AN15] Finally, if you like the tea tree, then do have a look at the levels of tannins, terpenes and sesquiterpenes.

[Slide AR26] components of Tea Tree

Conclusions

The full armoury of natural products is far from available comercially, however, when I think back to what was available 25 years ago and what is available today, then I am encouraged by the prolific growth in this sector.

Before I finish though, I would like to leave you with one little verse, which summarises everything that I have mentioned today:

[Slide AR30]

> **"Used at significant levels, plants are meaningful to the body,**
> **Used at insignificant levels they are meaningless to anybody."**

Don't let marketing try and convince you of anything that is different!

[Slide BA1] If you are new to the industry, I can assure you that we are all quite normal as this last slide shows.