Cropwatch Newsletter August 2007

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Toxicological Imperialism Issue

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§1. Editorial Comment: Regulatory Nonsense – How Much Longer Do We Have To Endure It Before Common Sense Prevails?

This summer 'Toxicological Imperialism' holiday issue covers two EU - related topics, and revamps two Cropwatch articles, which this particular Cropwatch subscriber-audience may not have previously seen before.

The Cropwatch-Perfume Foundation meeting with the EU Cosmetics Commission staff in Brussels (03-07-07) went well in spite of profound differences, and an account of the meeting is presented below in section §2. However this event has to be set against a background where even independent consultants & regulatory affairs personnel working within the cosmetics sector are becoming increasingly perplexed (as we are) at the seemingly nonsensical ingredient restrictions drawn up by private industry-funded research organisations & professional toxicologists, who advise & forward evidence to EU cosmetics regulators. Cropwatch is worried about the 'grooming' of regulatory officials by powerful amalgamations such as EFFA/RIFM/IFRA – we already have enough doubts about how an independent point of view can possibly be achieved at Brussels, when 'expert' committees are so dependent on industry-inputted information.

Returning to the EU-connected issues, the restrictions proposed for Fir, Pine & Spruce oil ingredients to be moved into Annex III of EU Cosmetics Directive 76/768 (see §2. Public Consultation document below) **defy common sense**, and are typical of imaginary & inappropriate risk scenarios dreamed up by safety organisation officials who have no hands-on experience of the industry, and thus how ingredients are typically used in product.

Meanwhile as Cropwatch previously disclosed, professional perfumery organisations such as the BFA now require that the managing directors of member companies sign up to a document promising to obey IFRA & EFFA CoP's. To us, this is tantamount to a gagging order, especially considering that increasing numbers of technical staff privately have deep reservations about the scientific validity of many IFRA Standards. Remember, that these Standards & CoP's are not legal requirements. Remember too, that IFRA's Compliance process is now firmly in operation (see IFRA Information Letter 779) - if member companies are picked up by an appointed third–party analyst (Batelle of Geneva) producing non-IFRA perfumes in finished retailed cosmetics, they may be named & shamed, or their representatives may,…err….have to appear before an IFRA committee and thence to a public flogging (OK, we made that last bit up!). Why any fragrance company would continue to be a paying member of a research organisation which doesn't trust its own members, & is prepared to witch-hunt them in this manner, is completely beyond us. It shows how cowed the aromaindustry has become to bullying, via an imposed regime of **toxicological imperialism.**

'Fear Culture' Amongst Perfume Buyers. The dread of media attention, & being featured in national newspapers by a chemophobic journalistic culture, causes sleepless nights for the world's fragrance buyers. All manner of possible ills have been ascribed to perfumes in the past few years, from allergy & asthma to respiratory illness to ocular damage, raising the possibility of litigation from supposedly affected fragrance end-users. Buyers believe, because of a long history of brainwashing, that unless their fragrances comply to IFRA Standards, that they are 'at risk', and they put pressure on fragrance producers to ensure that their purchased fragrances comply to every possible regulatory requirement. The 'suitable person' is clearly in a powerful position, appointed as he/she is by the fragrance customer to 'sign off' perfume safety certificates according to IFRA/EFFA, the EU Perfume Directive or whoever. He/she can clearly be able to dictate safety policy to the fragrance producer, and advise the fragrance buyer that they must adhere to the policies of certain organisations (EFFA, IFRA etc), based on their precautionary principle policies. However, these principles are so precautionary, that their ingredient restrictions severely affect the perfumery art, as the fragrance customer finds out when they receive an under-powered & flabby fragrance against a brief (as happens on many occasions). It is then the perfumer's job to indicate to the customer that if you eliminate all ingredients carrying some undefined level of risk, you get garbage perfumes – allowing them back, especially the naturals, improves both the fragrance & its performance.

So who is in charge in the perfumery profession, exactly? The balance of power is shifting to the regulatory affairs experts, who are currently engaged in a feeding frenzy, getting their wallets nice & fat, via the toxicologist's findings. Cropwatch supporters & sympathisers are prominent in seeing that this is an 'Emperors New Clothes' situation – if the risks of using particular ingredients are negligible in many cases, as we believe they are, then the whole stack of cards can fall down, if people just apply their common sense & make independent judgments.

Back to the plot! We also feature an update of an article entitled 'The Adulteration of Essential Oils', since, even although originally written four years ago, it is fast becoming a set piece for teaching in medical schools & aromatherapy courses. Further, it adds substance to an area that industry doesn't particularly want to either admit to, or talk about. For example RIFM has a history of examining the safety of what it believes are pure essential oils 100% botanically derived from the named source, & the SCCP may use these findings to form a safety Opinion on the pure ingredient. In reality however, fragrance concerns are frequently using adulterated oils & absolutes, & so we find ourselves caught up in a silly game of pretence, because regulators have no experience of industry practices.

Finally, another re-issued but updated article (§5 below) exposing more aroma myths, is also featured. This time we explore the dubious credentials of those attention-seeking academics who have debunked aromatherapy in national newspapers, & we expose the sales-hype surrounding the concept of

'therapeutic essential oils'. We also explore the dogma of the 'Functional Groups Theory', a piece of history still being taught in many aromatherapy school & college courses in the guise of aromatherapy science.

§2. Meeting Between Cropwatch - The Perfume Foundation & the EU Cosmetics Commission Staff, Brussels, July 3rd 2007.

[N.B. The following is Tony Burfield's personal account of the meeting proceedings, and does not represent the agreed minutes, or represent the opinions of the other attendees].

Introduction.

Representatives from Cropwatch and The Perfume Foundation met senior personnel from the EU Cosmetics Commission at their avenue d'auderghem offices in Brussels on the afternoon of Tuesday July 3rd 2007 for a meeting that lasted 1h. 40 mins. .

Tony Burfield, Co-founder Cropwatch
Creezy Courtoy, Chairman, Perfume Foundation
Henke Meijerink, Technical Director, Perfume Foundation
Sabine Lecrenier Head of Unit, Cosmetics Commission
Barbara Mentré, Administrator, Cosmetics Commission
Takis Daskaleros, Senior Administrator, Cosmetics Commission
Annette Orloff, Seconded National Expert, Cosmetics Commission

This cordial and constructive meeting started with individuals from all parties briefly explaining their respective roles, operating briefs & constraints. In what must be at times a difficult & maybe under-resourced position, the Commissioner explained the role of Safety Management & the role of DG Ent (Risk Assessment).

Areas of Improvement.

The Commission staff explained that Cropwatch's opinions had been instrumental into revisions of procedures Areas for improvement include transparency, data-gathering & the recruitment of further expertise e.g. in botany/economic botany. We all welcome attempts to strive for better standards & performance.

Areas of recommendation.

Cropwatch was deeply concerned at the level of reliance & trust placed with industry & its privately funded research organisations, both to provide scientific data to the SCCP, & to source authentic samples of cosmetic ingredients for scientific investigation. The forwarding (say, to the SCCP, by industry) of a careful selection of certain scientific publications on cosmetic ingredients can, of course, provide the potential to generate slanted Opinions & policy, unless balancing data from more comprehensive data-base searching is made available. Further, the opportunity for the continuing development of 'Corporate

Science' (as opposed to truly Independent Science) is surely present where so many industry-based toxicologists are busy employed feeding (often unchallenged) data into EU expert committees. There is a need for an independent assessor as a buffer between industry-generated information & EU scientific administrative staff & lawyers.

An urgent recommendation was also made by Cropwatch to independently establish sample authentication, batch tracking & purity data for proffered commercially sourced samples, & to send back submitted data where these requirements are not satisfactorily established. This will save a considerable amount of time in preventing the adverse reactions of ingredients being wrongfully ascribed to the substance under investigation instead of the synthetic impurities.

Areas of Disagreement

Cropwatch & the Perfume Foundation identified a number of areas where the parties have fundamentally opposing views. .

1. Cropwatch & The Perfume Foundation believes that we need to establish a **Fragrance Commission** which is specifically concerned with the matters concerning fragrance regulation. Fragrance covers not only cosmetics, toiletries & fine fragrances, but air-freshners, candles & incense, & household & miscellaneous categories also. The alternative can only be that the EU Cosmetics Commission urgently reforms, correct & modify its existing remits & practices.

2. **Risk-benefit analyses** for the evaluation of the safety of fragrance ingredients was ruled out as a` possibility by Takis Daskaleros in conversation. This is not acceptable to Cropwatch, who anyway believe that EU staff misunderstands the concept of 'benefit' in this context – but there was not an opportunity at the meeting to explore this point further.

3. Since fragrance is as much a high-art form as much as it is a science, the existing. tunnel-visioned approach by the present Commission to perfume safety to **the exclusion of socio-economic, ecological, cultural & heritage matters is simply not acceptable**. Joined-up thinking with regard to consequences of cosmetic policies needs urgent consideration, perhaps in conjunction with other EC or globally-based . At a time when we are all working for a better & greener planet, the Cosmetics Commission cannot excuse from the ecological consequences of its policies just because of its authoritative position. .

3. Although the Cosmetics Commission is responsible for seeing that manufacturers place safe cosmetics on the marketplace, the Commission point-blank **refuses to define "safety".** We believe that this position is untenable. European taxpayers are entitled to a quantification of the relative risks of using cosmetic preparations & ingredients. We further believe that the latest SCCP

operating CoP (which maintains that risk assessment quantitation is outside its scope) needs rewriting to justify its policies wrt to perceived risk.

4. Expanding point 3 above, joined-up thinking is especially applicable to the **socio-economic & ecological aspects** associated with banning or restricting cosmetic ingredients, where, as a consequence of natural ingredient usage decline, it causes hardship or threaten survival of the natural resource (cf. Peru Balsam forests in El Salvador). Cropwatch believes that cultivation or processing technical fixes are available for many of the adverse reactions produced by restricted ingredients, and we need to find funding solutions to help those social groups which are directly affected.

Individual Issues.

1. ***Furanocoumarins.*** We understand that the RIFM-contracted studies on the individual FCF's bergamottin & isopimpinellin which were undertaken by Prof. David Kirkland of Covance UK, have been forwarded to the SCCP. Cropwatch has asked that these privately submitted studies be made available for public scrutiny in the interests of transparency.

Cropwatch believes that limitation of FCF's to 1 ppm in cosmetic products will be economically divisive and set the stage for violation of Fair Trading Principles [i.e. it will selectively disadvantage SME's and those operating from undeveloped regions in the citrus commodity sector, who cannot afford the investment in technology to reduce FCF levels]. Cropwatch is further asking for a public consultation on the issue.

2. ***Inhalation toxicity.***

Cropwatch-Perfume Foundation representatives were somewhat aghast to learn that inhalation toxicity / allegations of adverse connections between perfume & breathing problems, asthma etc. hardly figured on the Commissions agenda, showing how much, in our opinion, dermatological matters have over-influenced EU cosmetic safety policy, to the detriment of other areas of concern. We were assured that this omission would be put right.

3. ***The single ingredient approach to toxicology.***

The FCF issue is a particular illustrative case where 'laboratory bench' investigations of the alleged toxicity of an isolated single component within a complex biological matrix may be completely misleading. We need protocols that investigate the toxicity of the actual complex ingredients themselves rather than isolated versions of the individual constituents of the ingredients, versions which are often impure (with unspecified impurities), or composed of the wrong isomer(s) compared with the natural isolate.

4. ***SCCP Reform.*** Cropwatch has been asking research teams who have submitted data to the SCCP (either indirectly via published papers, or who have submitted data directly to the SCCP), whether they consider that their work has

been fairly & correctly expertly assessed & reviewed in an unbiased manner. Although Cropwatch has only carried this out on a very limited scale, the results are alarming. An urgent internal investigation is needed.

Further, Cropwatch & many of its supporters do not consider Ian White as a suitably independent & unbiased chairman of the SCCP. We would like to have certain SCCP Opinions independently re-examined, and we intend to submit or publish evidence, to support this endeavor.

5. Subject areas for safety re-assessment. There is a large group of people with independent scientific opinions who do not necessarily agree with the findings, views and policy of the EU Cosmetics Commission, and most especially with its 'expert' advisers. These issues include the subjects of alleged **methyl eugenol** carcinogenicity, certain banned or restricted materials within the Cosmetics Directive, & the large & controversial subject of **alleged sensitisers** amongst common aroma ingredients.

Conclusions.
Although areas of disagreement are both considerable & deep, this initial meeting was very encouraging and sets an optimistic air for the future. Cropwatch would like to thank the Brussels staff for the valuable opportunity to dialogue and for each party to have an insight into each others' policies.

Tony Burfield
July 9, 2007.

§3. CROPWATCH COMMENTS Re: PUBLIC CONSULTATION ON PERFUMERY MATERIALS IN THE FRAMEWORK OF COUNCIL DIRECTIVE 76/768/EEC RELATIVE TO COSMETIC PRODUCTS.

Executive Summary.

Pine, Fir & Spruce needle oil ingredients, amongst others, are proposed to be moved into Annex III of Council Directive 76/768/EEC because of toxicological advice that, in isolation, 'oils of the Pinacea' with peroxide values equal to or over 10mmoles/L. carry a risk of skin sensitising properties. This proposal contrasts with the 20 mmoles/L. limit for limonene outlined in the same measures, and as limonene is a common component of the above oils, this discrepancy needs explanation. Cropwatch argues that at the normal dilutions used in fragrances, and because of the mechanical treatment employed in cosmetics & fragrance manufacture, the peroxide content of these natural ingredients will not persist in cosmetic products, & certainly not in concentrations which can cause skin sensitisation. Furthermore, inclusion of the sesquiterpene-rich aromatherapy oil of Atlantic Cedarwood (*Cedrus atlantica*) and the ketone-

rich Cedarleaf oil (*Thuja occidentalis*) in the Annex III proposed listing is bizarre, & not based on scientific reasoning.

Secondly, the EU regulators still have not asked RIFM to rework the previously submitted contention that allergenic properties are caused by any individual opoponax (*Commiphora*) species, of which five are well known (*C. erythraea* Engl. var. *glabrescrens* Engl.; *C. guidotti* Chiov. ex Guidottii; *C. holtziana* ssp. *holtziana* ; *C. kataf* (Forssk.) Engl.; *C. pseudopaoli* JB Gillet). Previously submitted evidence to the SCCP did not robustly botanically identify & audit track specific any opoponax (*Commiphora*) spp. before testing, as pointed out by Cropwatch in Sept 2005, and any inclusion of an opoponax resin source in Annex III is presently unsafe. Cropwatch is approaching traders who deal with these commodities from Eritrea, Somalia, Kenya & Saudi Arabia to enable more reliable studies.

1. Pre-amble.

By the time the trade was aware of this Public Consultation about perfumery ingredients proposed for moving into Annex III, as posted at http://ec.europa.eu/enterprise/cosmetics/doc/perfumeconsult200707.pdf, we were given a week during peak holiday time to respond (closing date Friday 27th July 2007). The undue haste at which EU cosmetic legislation is driven generates a continual need to correct EU document errors, which arise because of this forward pressure.

Cropwatch intends to make comments on socio-economic, ecological & trade implications of these proposed Annex II & III listings in its own time. It is clearly impossible, for example, to communicate & draw up arguments on behalf of those affected at 7 days notice – for example Eritrean, Somalian, Saudi Arabian & Kenyan opoponax (*Commiphora*) commodity collectors & producers, nor to assess the likely impact for fir, spruce & pine oil distillers.

Some botanical errors in the Cosmetics Inventory previously noted to the EU Commission / SCCP by Cropwatch in Sept. 2005, are disappointingly still uncorrected in the Public Consultation document detailed above. The EU Cosmetics Commission still needs botanical expertise to clear up botanical nomenclature errors & ambiguities, so that European industry & European consumers can clearly understand which, precisely, are the identities of the materials intended to be defined in the legislation.

2. Fir Needle Oils: the Changes in Annex III list of ingredients still contains botanical errors & omissions.

1. Under 'New Entries in Annex III Part 1, the *Abies pectinata* De Colle entry can be scrubbed out, since it is synonymous with *Abies alba* Miller, already listed. This was previously pointed out to the SCCP by Cropwatch in Sept. 2005.

2. Commercially important fir needle oils such as *Abies grandis* (Douglas ex D. Don) Lindley and *Abies nordmanniana* (Stephen) Spach., do not appear on the list.

A more complete & accurate commercially important fir needle oil commodity listing should appear like this:

Fir (*Abies*) species	**Name of Derived Commodity**
Abies alba Mill. syn *Abies pectinata* (Lam) DC CAS n° : 8021-27-0	Silver Fir Cone, & Needle & Twig Oils
Abies balsamea (L). Mill. CAS n° : 8021-28-1	Balsam Fir Needle & Twig oil syn. Canadian Fir Needle & Twig oil
Abies grandis (Douglas ex D. Don) Lindley	Giant Fir Needle & Twig Oil
Abies sibirica Ledebour CAS no 91697-89-1	Siberian Fir Needle & Twig oil (often sold as Pine oil Siberian)
Abies nordmanniana (Steven) Spach. & *Abies nordmanniana* subsp. *Nordmanniana*	Crimean Fir Needle & Twig oil syn. Black Sea Fir Needle & Twig oil

Table 1. Commonly traded Fir Needle Oils.

Cropwatch argues the 10mmol/L. peroxide restriction is inappropriate.

Fir Needle oils are used in fresh piney and pine-herbal fragrances for foam-baths and shower products, and are used in medicinal applications, such as in products for inhalation. They also find application in men's fragrances for their fresh piney-balsamic notes, and in candles, seasonal products, pot pourris etc. Fir oils have always been subject to adulteration, with pinenes, bornyl acetate, isobornyl acetate, etc., although extending the essential oil with these materials often gives a dirty and confused odour profile.

Fir needle oils are typically used at the following concentrations in various applications:

Application	**Fragrance concentration in Application**	**Fir Needle Oil %-age in Fragrance**
Foam-baths	Typically 1%, range is 0.5% to 2.0%.	Normally 1-5%; rarely up to 25% for natural fir needle/aromatherapy type blends.
Bath crystals	Typically 1%	Normally 1-5%
Bath oils	Typically 1%	Normally 1-5%; rarely to 25% for natural fir needle/aromatherapy type blends

Shower products	Typically 1%, range 0.5% to 2.0%.	As for foam baths above
Pot-pourris	Typically 5%, range 3% to 8%;	1-5% standard.
Male fragrances	Up to 10% (cologne)	0.2% to 1.5%, rarely to 2.5%
Candles	Typically 5%; range 2 to 10%	0.5 to 5% occasionally to 20%
Aerosol Air freshners	1% typical.	0.5 to 2.5%

Table 2. Fir Needle Oils – typical concentrations in fragranced products

It can easily be seen that at typical usage rates for products washed off the skin, the fir needle oil concentration rarely exceeds 25% in the fragrance, and the fragrance itself is only used at up to 2% in product. Therefore fir needle oil concentration in product is only 0.5% max. and more usually as low as 0.01%. For male fragrances not washed off the skin, such as a cologne, the perfumes content would typically be 10%, of which the concentration of fir needle oil is 1.5% - perhaps rarely to 2.5% max. The maximum concentration of fir needle oil applied to the skin in male fragrances is therefore 0.25%. We contend that in all these instances, that the dose of fir needle oil to the skin, even if the oil has a peroxide value of up to 20 mmoles/L., is insufficient to cause a skin sensitisation reaction.

It is particularly significant that whereas the proposed restriction on fir needle oils is set at a peroxide limit of10mmoles/L., the proposed restriction for limonene is double this figure at 20mmoles/L. Why fir (and pine and spruce) needle oils should present more of a toxicological risk than limonene is not explained (oil of *Abies alba* contains approx. 20% limonene for example). This gives the impression that these figures are quite arbitrary.

It is further unproven that the hydroperoxides of monoterpene hydrocarbons (such as limonene, terpinolene & δ-3-carene) contained in peroxide-positive fir needle oils survive the perfume compounding process (i.e. when they are intimately mixed by a mechanical stirrer for several hours, together with the other ingredients of the fragrance). Since peroxides are both mechanically & physio-chemically fragile, and extremely chemically reactive, they may easily interact with other aromatic ingredients and destroy themselves during the perfume maturation process. Their presence in finished perfumes remains speculative – hydroperoxides decompose on most GC columns, and starch-iodide titration methods, which may be suitable for single ingredients, is problematic & insensitive with finished fragranced cosmetics.

The remit of the SCCNFP in their Opinion SCCNFP 0389/00 was that: “Essential oils and isolates derived from the Pinacea family, including *Pinus* and *Abies* genera, should only be used when the level of peroxides is kept to the lowest practicable level, for instance by adding antioxidants at the time of production.

Such products should have a peroxide value of less than 10 millimoles peroxide per liter. Based on the published literature mentioning sensitising properties when containing peroxides (*Food and Chemical Toxicology* **11**,1053 (1973); **16**,843 (1978); **16**,853 (1978)". However this fails to take account of industry practice.

1. Traded fir, pine and spruce needle oils, at point of receipt, range in peroxide value from 3-30mmoles/L. with average of just under 10mmoles/L. (Cropwatch unpublished data). Sparging the container headspace with inert gas (argon or nitrogen), which might prevent peroxide build up on storage, is not a normal procedure in many producing companies.

2. The IFRA/SCCP advice to add anti-oxidants at time of manufacture is not acceptable to much of the essential oil buying market, who demand pure essential oils 100% derived from the named botanical source, with no additives, synthetic or natural.

3. The presence of anti-oxidants in essential oils can cause technical problems in product which inhibit use.

4. When pine/fir/spruce needle oils are taken from factory stock to be compounded with other aroma ingredients into perfumes, the peroxide value is not routinely checked. When it is considered that individual compounded perfumes may consist of 30-120 ingredients drawn from a factory stock inventory of 1100 to 1600 possible ingredients, to quality control every ingredient before use would defy what is humanly possible.

The situation clearly needs re-assessment. However at this stage, the need for a proposed peroxide limit of 10 mmole/L. for fir needle oils under Annex III seems both inappropriate & irrelevant, and should be withdrawn.

3. Pine Needle Oils: the Changes in Annex III list of ingredients contains botanical errors & omissions.

Again, a more complete & corrected listing for commercially important *Pinus* spp. should read like this:

Pine (*Pinus*) Species	**Name of Derived Commodity**
Pinus cembra L. CAS n° : 92202-04-5	Arolla pine needle & twig oil syn Swiss Stone Pine Needle & Twig oil
Pinus divaricata (Aiton) Dumont de Courset.	Jack Pine needle & twig oil
Pinus mugo Turra CAS n° :90082-72-7 & *P. mugo* Turra var. *mugo* Zenan CAS n° : 90082-73-8	Dwarf mountain pine needle & twig oil

Pinus mugo var. *pumilionis* (Haenke) Franco CAS n°: 90082-73-8	Pumilio pine needle & twig oil syn. Dwarf mountain pine needle & twig oil
Pinus nigra Arnold & *P. nigra* var. *nigra* CAS n° : 90082-74-9	Austrian Pine oil
Pinus palustris P. Mill. CAS n° : 97435-14-8	Longleaf Pine oil
Pinus pinaster Aiton. CAS n° : 90082-75-0	Maritime Pine needle & twig oil
Pinus ponderosa P & C Lawson CAS n° : 97553-47-4	Ponderosa pine needle & twig oil
Pinus roxburghii Sarg.	Chir Pine oil
Pinus strobus L.	Eastern White Pine needle & twig oil
Pinus sylvestris L. CAS n° : 8023-99-2	Scotch Pine needle & twig oil
Pine oil Chinese CAS n° : 908002-09-3	Pine oil Yarmor
P. ayacahuite, Pinus elliottii Engelm. (Slash pine), *P. kesiya* Royale ex Gordon, *P. pinaster* Aiton, *P. halepensis* Miller (Alleppo pine), *P. merkusii* (Merkus pine), *P. sylvestris* L. (Scots pine), and *P. teocote* Schiede ex Schldl. & Cham.	:*Pinus* species used to produce Turpentine oil CAS n° : 8006-64-2.

Table 3: Commonly traded pine/ pine needle oils

Cropwatch argues the 10mmol/L. peroxide restriction is inappropriate.

Pine oils are used particularly in bath products including foam baths, bath crystals, shower gels, and bath oils; also in air fresheners, cleaning products and household perfumery. It is also used in Scandinavian tradition of saunas and steam baths, and originally in Swedish massage, and in bath preparations to ease sore muscles. Pine oils are also used in aromatherapy massage (typically at 2% (range 0.5% to 2.5%) in a vegetable oil vehicle); the essential oil of *Pinus sylvestris* being most commonly employed in interventions because of their alleged wide therapeutic value (which can be traced back as far as Dioscorides and Galen). Intended therapeutic benefit for *Pinus* oils center around rheumatic and pulmonary conditions, colds, chills and fatigue, and the applications are echoed in commercial products as mentioned above.

Pine oils are used particularly in bath products including foam baths, bath crystals, shower gels, and bath oils; also in air fresheners, cleaning products and household perfumery. It is also used in Scandinavian tradition of saunas and steam baths and in bath preparations to ease sore muscles.

Application	Fragrance concentration in Application	Pine Oil %-age in Fragrance
Foam Baths	Typically 1%	Normally 1-5%; rarely up to 25.0% for natural pine needle/aromatherapy type blends.
Bath Crystals	Typically 1%	Normally 1-5%
Shower Products	Typically 1% but range can be 0.5% to 2.0%	As for foam baths above
Bath Oils	Typically 1% up to 5%	Normally 1-5%; rarely to 25% for natural pine needle/aromatherapy type blends
Male fragrances	Up to 10%	0.2% to 1.5%, rarely to 2.5%
Candles	Typically 5%; range 2 to 10%	0.5 to 5% occasionally to 20%
Aerosol Air freshners	1% typical.	0.5 to 2.5%

Table 4. Fir Needle Oils – typical concentrations in fragranced products

The same remarks above for fir needle oils, apply to pine needle oils – for fragranced products not washed off the skin, the pine needle oil concentration rarely exceeds 25% in the fragrance, and the fragrance itself is only used at up to 2% in product. Therefore the pine needle oil concentration in product is only 0.5% max and more usually may be as low as 0.01%. For male fragrances not washed off the skin, such as a cologne, the perfumes content would typically be 10%, of which the concentration of pine needle oil is 1.5% - perhaps rarely to 2.5% max. The maximum concentration of pine needle oil applied to the skin is therefore 0.25%. We contend that in all these instances, where the dose of pine needle oil to the skin (even if the oil has a peroxide value of up to 20 mmoles/L.), is insufficient to cause a skin sensitisation reaction.

Further, as for fir needle oils above, there is no proof that hydroperoxides in autoxidised pine oils persist after the perfume ingredients are mixed for several hours to construct the blended perfume. The restriction on peroxide containing pine oils under Annex III is therefore inappropriate & irrelevant.

NB. Pine oil Chinese qualities are variable in composition, but oils containing 55% α-terpineol, and negligible concentrations of α-pinene, limonene or δ-3-carene are common, and so not liable to generate skin sensitising hydroperoxides, and need not be considered further.

4. Spruce Needle Oils: the Changes in Annex III list of ingredients contains omissions.

A more representative commercial listing should read like this:

***Picea* Species**	**Name of Derived Commodity**
Picea abies (L.) Karst syn *Picea excelsa* CAS n° : 9008-80-6	Common (Norway) Spruce needle & twig oil
Picea glauca Moench (Voss)	White Spruce needle & twig oil
Picea mariana (Mill.) Britt., Sterns and Pogg. CAS n° : 91722-19-9	Black Spruce needle & twig oil

Table 5: Commonly traded spruce needle oils

Cropwatch argues the 10mmol/L. peroxide restriction is inappropriate.
Spruce oils are used in perfumery to impart fresh notes to men's fragrances and in piney-herbaceous bath products. Similar usage criteria apply to this ingredient and similar conclusions apply to any proposed restriction under Annex III.

5. Additional oils 'from the Pinacea' – who's inclusion is apparently validated by footnote 14 in the Public Consultation, which refers to SCCNFP Opinion 0389/00.

However, in a new departure, the Public Consultation document has seen fit to include four entries from the Cupressaceae (seemingly, just on the basis they were mentioned in SCCP 0389/00 as being 'members of the Pinacea').

Entries from Cupressaceae Family	**Name of Derived Commodity**
Thuja occidentalis L. CAS n° : 8007-20-3	Cedarleaf & twig, & stem oils (i.e. 2 separate entries).
Cedrus atlantica (Endl.) Manetti ex Carr CAS n° : 8003-85-6	Atlas Cedar wood oil
Cupressus semperviens L. var. *stricta* Aiton CAS n° : 8013-36-3	Cypress (terminal branch) oil

Table 6: Other inclusions from the Cupressaceae for suggested movement into Annex III

The first two listed oils contain either high levels of sesquiterpene hydrocarbons (*Cedrus atlantica*) or monterpenic ketones (*Thuja occidentalis*), whereas the RIFM evidence noted above on which peroxide levels are proposed to be restricted, are largely based on hydroperoxides arising from the presence of a high monoterpene hydrocarbon content in the commodity e.g. from contributions made by peroxides of limonene, δ-3-carene & terpinolene etc. etc. Therefore:

1. If the Commissioners propose to include other members of the Pinales in Annex III, why haven't the major oils Texas & Virginian Cedarwood oils (*Juniperus* spp.) been considered, since their annual production tonnage (for Texas Cedarwood oil) is approx seventy times that of the above listed *Cedrus atlantica* ?

2. The above eventuality of including other members of the Pinales in (1.) above can only occur if the SCCP can supply evidence that essential oils containing high levels of sesquiterpene hydrocarbons and very low levels of monoterpene hydrocarbons are actually sensitising to human skin. This has not been satisfactorily demonstrated.

3. If (2.) above is proven (pretty unlikely), the SCCP needs to additionally review the safety data for sesquiterpene hydrocarbons (i.e. α-cedrene, β-caryophyllene etc.) sold into the fragrance industry, and include them too on the listing.

Until a time when the above criteria are fulfilled, the entries for *Thuja occidentalis* & *Cedrus atlantica* need to be removed, as their listing is scientifically invalid.

6. Other listed materials.

"Opoponax chironium resin" CAS no 93384-32-8

This entry needs to be removed. Cropwatch previously objected to the EU Cosmetics Commission & the SCCP (Sept 2005) about the use of the outmoded botanical descriptor "*Opoponax chironium*" in the SCCP Opinion 0871/05. An abbreviated extract from the Cropwatch objection is presented below:

"Originally thought to derive from '***Opoponax chironium***', Burfield (2001), Guenther (1950), Mabberley (1998), Langenham (2003), Gachathi (1997) and others, describe opoponax qualities deriving not only from ***Commiphora erythraea*** Engl. var. ***glabrescrens*** Engl. growing in Somalia, Kenya, E. Ethiopia, and S. Arabia., but also from other species such as (see table below):

***Commiphora* sp.**	**Common name**	**Distribution**	**Remarks**
C. erythraea Engl. var. *glabrescrens* Engl.	**Source of opoponax**	Somalia, Kenya, E. Ethiopia, and S. Arabia.	Fragrance ingredient
C. guidotti Chiov. ex Guidottii	**Source of opoponax/scented myrrh**	S. Ethiopia, Somalia.	Fragrance ingredient; extract is anti-diarrhoeal.
C. holtiziana ssp. *holtziana* syn. *C. caerulea* Burtt.	**Source of opoponax**	Kenya	Fragrance ingredient; tick repellent. Popular use on animals in USA (Gachathi 1997)
C. kataf (Forssk.) Engl.	**Source of opoponax**	N. Kenya to S. Arabia incl. Yemen.	Fragrance ingredient
C. pseudopaoli JB Gillet syn. *C. paolii* Chiov.	**Source of opoponax**	N.E. Kenya	Tick repellent. Popular use on animals in USA

			(Gachathi 1997)

Table 7. Opoponax resin-producing *Commiphora* spp. (abridged from Cropwatch documentation Sept 2005, compiled from various sources incl. Gachathi 1997).

The SCCP, in their Opinion SCCP/0871/05, referred to the previously unpublished work of RIFM. We have been presented with no published audit tracking from identifying botanist to dermatology researcher for these ingredients. RIFM need to repeat their work with correctly identified & tracked materials before any unbiased person can accept that any specific *Commiphora* spp. is associated with adverse dermal allergy reactions. Cropwatch accepts that identification of *Commiphora* species is problematic since individual species are morphologically difficult to distinguish from one another, & their gregarious nature means that several species invariably grow together. However sound science is what industry members collectively pay $8 million annually for RIFM to produce, and the organisation needs to respond to this challenge.

It is also the case that 'pure' cosmetic ingredients – like very pure coumarin – are (still) being investigated to prove that they are not sensitisers (***Cropwatch comments:*** well placed sources tell us that there will be more evidence forthcoming on this topic). If dual standards are to be avoided between synthetic & natural products, then rigorous identification, authentication & tracking for complex botanical materials needs to be in place – presently we don't have it in presented evidence to the SCCP.

References.

Burfield T. (2001) *Natural Aromatic Materials – Odours and Origins* pub. AIA Tampa 2001.

Gachathi F. N. (1997) "Recent Advances on Classification and Status of Main Gum-Producing Species in the Family Burseraceae" available at http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/X0098e/X0098e01.htm

Guenther (1950) *The Essential Oils* Vol 4.

Langenham J. (2003) *Plant Resins: Chemistry, Evolution, Ecology, Ethnobotany* Timber Press, Portland, Oregon.

Commiphora erythrea var. *glabrescens* Gum Extract and Oil

CAS no 93686-00-1

Presumably this is the intended entry for opoponax qualities, not the spurious *Opoponax chironium* listing above. Independent observers, including Cropwatch, do not accept that RIFM staff & research contributors have unambiguously identified this individual named *Commiphora* species before sensitisation testing in the evidence presented to the SCCP (commercial opoponax resins can often be a mixture of several individual *Commiphora* spp. as indicated above, or include other 'non-opoponax' *Commiphora* spp). For example gum myrrh is another aromatic resinous commodity from Commiphora spp., & Dekebo (2002) has indicated that gum myrrh frequently contains gums of *C. sphaerocarpa* and

other *Commiphora* spp., adding to the picture of widespread *Commiphora* commodity adulteration).

Furthermore the conclusion of the SCCP Opinion 0871/05 states (we have super-imposed a division it into 3 parts):

"1. The term opoponax is used to describe a variety of derivatives/extracts of non-defined compositions obtained from *Commiphora Erythrea Glabrescens* (***Cropwatch comments:*** this is botanically inaccurate, as other *Commiphora* species are involved, as indicated above).

2. The provided data do indicate that *Commiphora Erythrea Glabrescens* has an allergenic potential.
(***Cropwatch comments****:* We contest this, as the commodity tested was not rigorously identified as coming from this species – rather it was only **assumed** to come from this species).

3. However, the quality of the submitted data is poor. Nevertheless, under the conditions of its anticipated use as a fragrance ingredient (maximum 0.6 % in the finished cosmetic product), the risk of sensitisation is low."
(***Cropwatch comments***: Inconsistent levels of required proof are a negative feature of SCCP Opinions. For example, the very high level of proof required in the SCCP Opinion SCCP/0935/05 to prove that coumarin is *not* a sensitiser contrasts with this decision above for opoponax, where poor levels of evidence are actually admitted by the Committee, but the restriction is still nodded through).

Cropwatch's conclusion: The listing for *Commiphora erythrea* var. *glabrescens* (opoponax) qualities is unsafe and should be withdrawn until scientifically robust proof from properly identified ingredients is offered.

The original Cropwatch objection to the SCCP Opinion 0871/05 is appended below, since it provides references to key articles on opoponax gathered over the last 60 years of research, which the SCCP committee failed either to find, or to take into account.

Reference:

Dekebo A., Dagne E. & Sterner O. (2002) "Furanosesquiterpenes from *Commiphora sphaerocarpa* and related adulterants of true myrrh." *Fitoterapia – Milano* **73**(1), 48-55.

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Appendix 1 [– previously submitted material to the EU Cosmetics Commissioner/SCCP on opoponax ("Initial Cropwatch Objection to SCCP Opinion on Opoponax (Sensitisation Only) SCCP/0871/05") – was appended. We won't reproduce it again here – it can be found at http://www.cropwatch.org/cropwatch.htm under the 'Cropwatch 11' heading**]**.

§4. Naked Aromatherapy - the Truth Laid Bare.

[Updated Aug. 2007 from an article in Aromatherapy Today Aug 2006 by Tony Burfield & Kendra Kirkham].

Defining Aromatherapy.

Aromatherapy does not have a universally agreed definition in terms of either how aromatherapists see themselves, or how the world comprehends the practice. In France, aromatherapy is sometimes utilised as a medical intervention, backed as it is, by a study of the therapeutic properties and actions of essential oils; in Australia, New Zealand, the United Kingdom, certain US states & some other countries, Aromatherapy is more likely to be defined according to its application in generating revenue i.e. paid massage using essential oils, mood enhancing marketable products etc. The fragrance trade has borrowed the term 'Aromatherapy' to convey the idea that a part-synthetic fragrance can change one's mood – a concept better defined by the term Aromachology.

Aromatherapy is conventionally described as the (invariably holistic) use of essential oils in a therapist-client intervention to promote health & well-being – except that even this description underplays the fuller meaning, since many aromatherapists believe that essential oils have the potential to heal, above and beyond that of having the specific potential of being, in effect, a mere relaxant or antiseptic. There is a growing belief amongst practitioners that the first effects from smelling a particular essential oil or blend are energetic, and work at an adaptogenic level (having a normalizing action irrespective of the direction of the pathological state)[1] therefore addressing the underlying cause or imbalance responsible for a particular disease state. Therefore any required therapeutic actions will naturally occur if the correct energetic choices are made (: treating the person rather than the disease is reminiscent of the philosophy found associated with many traditional healing modalities.

The confusion over the meaning of the term aromatherapy, the lack of a coherent identity, the mix of scientific and empirical evidence used in its defence by protagonists, its adopted traditional models, and the multitudinous anecdotal references invariably heard coming from aromatherapists lips, provides vulnerability for those who would criticise it.

'Slagging-off' Aromatherapy.

Criticism of CAM (complimentary and alternative medicine) is readily applauded by the media, and pleases many in conventional medicine, especially those connected with the pharmaceutical and chemical trades. Perhaps the most recent example of this is seen in the press coverage given to Dr. Neil Martin of UK's Middlesex University who recently conducted a study (which we gather is yet unpublished) to test what he claimed was "the strongest form of the aromatherapeutic hypothesis: the suggestion that "**exposure to a pleasant odour can alleviate pain."** (we have yet to locate *this* definition, if in fact it exists at all).

Martin tested this "major aromatherapeutic hypothesis" by subjecting 60 people to the pain-generating discomfort of having their hands plunged in freezing cold water for 15 minutes whilst either smelling lemon essential oil, machine oil or smelling air with no purposely added odour. Martin reported that "Individuals exposed to both odours reported significantly greater pain than did control participants at five minutes. At 15 minutes, individuals exposed to the unpleasant odour experienced significantly greater pain than did the control group". These results it seems gave Neil Martin the license to propose to entitle his paper **"**The failure of aromatherapy? The effect of exposure to odour on the perception of pain**".**[2]

Martin fails to understand that this study has absolutely nothing to do with aromatherapy – there is no aromatherapeutic intervention, no therapist-patient interaction and no lasting healing prospect. It might have something to do with aromachology – the study of volatile chemicals that temporarily affect mood & the senses – but then why choose lemon oil? As far as **we** know lemon is not known for its anesthetic effects – unless mixed with copious amounts of vodka and consumed orally. Even then we'd put our money on the vodka, not the lemon! In reality, these sorts of press stories are absurd – they tell us more about the miscomprehensions & shortcomings of the investigators and journalists writing up the story than they ever do about the subject they are supposed to be investigating.

Background / Roots of Aromatherapy Practice

There is disagreement in some quarters concerning whether aromatherapy is essentially derived from perfumery, or from herbal medicine, or is an amalgamation of both. It is certainly important to acknowledge that the aromatherapy profession is very young compared with Herbalism, Ayurveda, TCM and many other comprehensive CAM therapies.

Physical application of essential oils via massage is the dominant mechanism employed by most aromatherapists practicing in the west. Aromatherapy education in this respect has been confused from the start. Most aromatherapy diploma courses teach "Swedish massage" techniques as standard. These techniques do offer undoubted benefits such as increasing the circulation and

promoting relaxation and were taught to aromatherapists in the early days as a convenient vehicle for delivery of the oils, (the massage element not being of great importance) The system strangely uses French terminology and further, we do wonder why it is called Swedish massage in the first place as many Swedes have never heard of it.

Swedish massage has been popularly utilised in beauty salons and spa's, using set routines and many professional aromatherapists are now employing more intuitive and individualised massage techniques which traditionally form part of complete traditional medical systems with traceable and highly revered lineages (e.g. Thai massage/Ayurvedic massage) as these seem capable of working at much deeper levels.

From the point of view of the average client, a massage treatment will not vary greatly from one to the next in Thailand – 'you know what to expect', broadly speaking. The opposite is the case for aromatherapy treatments in the West where there are complex differences in the way we utilise essential oils, a huge variation in massage techniques employed and no traditional healing model to use as a reference. This lack of a traditional model is responsible both for the rich diversity of treatments on offer but also for the lack of a coherent identity.

There are two main reasons for the lack of unified image portrayed to the general public & media etc., and why we are not fully unified as a profession. The first reason is the lack of the afore-mentioned traditional model to draw upon; the second reason is that we do not always question sufficiently what we have been taught and have come to accept, quite apart from the fact that the quality of much of aromatherapy teaching is substandard and does not often reference/prove its concepts & claims. The near-worshipful status of aromatherapy guru's amongst the faithful is almost pitiful to behold, all the more so because their dubious pronouncements are swallowed wholesale without being significantly questioned or challenged.

In view of the concerted campaign to discredit natural therapies in the media, a shift simply has to happen since all eyes are upon us. Further, the heavy hand of legislation approaches and will inevitably demand regulation of the profession. We need to establish a greater level of professionalism and accountability, and the time has come to heed these warnings & help to shape a better future for the profession.

Dissolving Pseudo-Science in Aromatherapy.

The predominant philosophy today for modern analytical scientific-based thinking is exerting a pressure that Aromatherapists feel that they have to respond to, in their desire to gain a wider acceptance in conventional society. This is difficult because in our work, we respect and embrace healing principles that have their roots in traditions that boast thousands of years of empirical wisdom & so we find ourselves caught in the middle of two opposing forces - our own holistic

predisposition, and a pressure to conform to the dictates of what we often feel is a limiting but necessary scientific demand that we 'prove' ourselves.

Aromatherapists are therefore being pulled in two directions - between true intention, and the pressure to conform to conventional science. This leaves a space where pseudo-science has found a home, and we find ourselves struggling with false concepts that cannot take us to where we want to go.

This is the first in a series of articles that set out theories, philosophies and beliefs that aromatherapy as a profession has adopted, but that, in reality, are not workable, not helpful. and compromise our identity, our professional standing and our right to be taken seriously.

Functional Group Theory.

Aromatherapists are not particularly noted for having a good grasp of chemistry, and no finer example of this can be found in the widely taught functional group theory. Franchomme's hypothesis (that the inherent properties of functional groups of the major constituent molecules of essential oils could explain the therapeutic properties of essential oils), were continued in the teachings of his own French school, and he influenced other aromatherapy teachers such as Rodolphe Baltz, who describes the therapeutic properties of over 200 essential oils in his book *The Healing Power of Essential Oils*. The theory was further advanced by Franchomme and Penoel's major pharmacological work in French - never translated into English - *l'Aromatherapie Exactement* pub. Jollois (1990) ISBN 2-87819-001-7. By now a number of French & English aromatherapy schools were teaching the principles of the hypothesis, and the Franchomme school of thought was further advanced by Kurt Schnaubelt (of the Pacific Institute of Aromatherapy) in the USA who went on to market the very successful *Advanced Aromatherapy* published by Healing Arts Press (English translation in 1998) ISBN 0-89281-743-7, which describes the hypothesis in a highly graphical manner over pages 51-95. In a key statement on page 52, Schnaubelt acknowledges Franchomme's contribution to aromatherapy which he describes as "…to acknowledge the impact that the tendency to donate or subtract electrons has on the properties of an essential oil component".

The problem is, that in the simplistic form the hypothesis tends to get reduced to, by some aromatherapy teachers – aldehydes are anti-inflammatory, ketones are toxic etc. etc. – and this is, in our view, complete nonsense. Robert Tisserrand, then editor of the *IJA*, threw down the gauntlet to Schnaubelt in the form of an editorial in *IJA* **9**(2), challenging him to offer one shred of scientific evidence that the "theory" actually works. Schnaubelt subsequently gave a somewhat weak reply in *IJA* **10**(2) p 62-3 suggesting that the true origin of the hypothesis (rather than theory) lay originally with the chemical classifications by the French fragrance companies Charabot & Dupont. He further implied that the functional hypothesis does not explain all the properties of essential oils, but is observed more favourably in monoterpenoids where lipophilicity and

electrophilicity/nucleophilicity can be important. Schnaulbelt conceded that the "one-dimensional pharmacology" involved (with the functional group hypothesis) was limiting, and that aromatherapy conceivably works through the action of hundreds of components, including the minor ones. It's a pity that these admissions were not included in *Advanced Aromatherapy* – instead the footnotes to Franchomme's original work remark that the results are not undisputed, but he argues that the model is convincing and that they (the results) "…establish a sensible if somewhat rough system of oils and their qualities which has proven itself empirically over the past ten years".

Penoel also defended the molecular functional approach in *IJA* **9**(4) p162-3 conceding the reportage of the 'molecular approach' had resulted in an oversimplified and generalised approach. For example, he remarks that the statement that all ketones are neurotoxic is now not universally agreed [indeed it is not – for example the ketone fenchone which occurs up to 12% in bitter fennel oil *Foeniculum vulgare* Miller, is not that relatively toxic].

However Penoel further stated that the afore-mentioned approach offered more advantages than drawbacks. Penoel goes on to distinguish between three systems: single oils, horizontal functional molecular synergies between essential oils (blending oils with similar functional groups) and vertical functional molecular synergies (blending oils with different functional groups). Because many aromatherapists have learned through careful and close study of holistic herbal principles, that essential oils are a complex synergistic mixture of constituents, the whole being greater than the total sum of its parts, why then would they readily believe that these singular identified moieties *of themselves*, that can trigger a particular action in isolation, would necessarily facilitate that very same action in the whole oil in which they are contained?

With all this discredit as a background, it is surprising that the functional group hypothesis still remains a central part of aromatherapy dogma today, to the extent that (for example) Rosemary Caddy's popular high street book is a set book for aromatherapy students to study, in the initial proposal by the collective wisdom of the Syllabus Committee of UK's *Aromatherapy Consortium* (well anyway, when we last looked). What hope for aromatherapy if its would-be regulators do not keep up with events in modern aromatherapeutic thought?

'*Therapeutic Grade' Essential Oils.*

Many aromatherapists have unfortunately become unwitting victims of a marketing ploy by essential oil traders that advertise "approved" essential oils of 'therapeutic grade'. Let us be quite clear on this - there is no such thing as a 'therapeutic grade' essential oil, and no quality standards for the authentication of essential oils specifically exist in aromatherapy - professional aromatherapy have individually & collectively failed to issue aromatherapy oil standards, in spite of individual schemes being put forward (e.g. the initiative of Jones, 1998).

Existing Standards.

Over the years there have been a number of bodies that have laid down working standards for essential oils, often geared towards the pharmaceutical, food or fragrance sectors, but these standards are entirely unsuitable for essential oil quality monitoring in aromatherapy, as, (for example) they do not consider sufficiently the appropriate chemotypes employed, or the preferred geographic origins of the oils.

Briefly, essential oil standards for the pharmaceutical trade are published in the form of national Pharmacopoeias - the exorbitantly expensive BP (British Pharmacopoeia) for example, is published on recommendation of the Medicines Commission UK. There are also pharmacopoeias for individual nations, such as the USP (: the Unites States Pharmacopoeia), and for nations such as those of China, India, etc. It is important also to mention the widely consulted European Pharmacopoeia, now currently in its fifth edition.

Also in the US, a collection of monographs on individual essential oils (EOA Standards) were produced several decades ago by the Scientific Committee of the Essential Oil Association Inc. for use by the essential oil trade. The specifications for these older standards were geared in some cases especially towards US home-produced oils (e.g. for peppermint oil) which has attracted some subsequent criticism from producers in other countries (India, Russia etc.) trying to produce commodities conforming to these specifications. In France, the Association Française de Normalisation (**AFNOR**) produces the standards for their oil trade. Australian Standards for essential oils (e.g. AS2785-1985 for tea tree oil) also exist, but since for example over 90% of Australian tea tree oil is exported, compliance to international essential oil standards is more imperative.

The Food Chemicals Codex (FCC V), now in its fifth edition, was initially produced at the request of the FDA (1992), and is widely used for ingredient specification guidance by the food flavourings industry. Many larger established flavour & fragrance houses have their own internal purchasing standards for essential oils, but perhaps the main independent certifying body recognised is now the International Standards Organisation (ISO Standards TC 54) which publishes universally accepted standards for individual essential oils.

It is not unusual in certain sectors of the food and flavourings sectors to modify or adulterate particular oils in order to meet the requirements of their corporate clients, but essential oils for use in aromatherapy should be produced by purely physical means and be 100% pure and wholly derived from the named botanical source.

So - one of the biggest so-far-unresolved dilemmas aromatherapists face, is how to tell whether an oil they wish to purchase fulfils the requirements of quality and purity. Many feel that they have to rely on the supplying company for information

or ‘word of mouth’ testimonials. Inevitably certain companies play on the gullibility of their customers to make unsubstantiated claims.

Enter YLEO.

Young Living Essential Oils (YLEO) have been prominent in using the term ‘therapeutic quality’ in relation to essential oils as marketing hype. On www.therapeutic-grade.com we find the following YLEO definition of "therapeutic grade" essential oils:

"In Europe, AFNOR (French Association of Normalization) and ISO (International Standards organisation), which has set standards for therapeutic-grade essential oils adopted from AFNOR) provide a set of standards that has been established, outlining the chemical profile and principal constituents that quality essential oils should have. These are widely regarded as the gold standard for testing essential oils. The AFNOR standard is most stringent, and differentiates true therapeutic-grade essential oils from similar Grade A essential oils with inferior chemistry. AFNOR standards state the percentages of certain chemical constituents that must be present for an essential oil to qualify as truly therapeutic-grade. As a general rule, if two or more marker compounds in an essential oil fall outside their proper percentages, the oil may not meet the AFNOR standards. These guidelines help buyers differentiate between a therapeutic-grade essential oil and lower grade oil with a similar chemical makeup and fragrance." (See update on this below).

Cropwatch Investigates. The plain truth is that a spokesperson for AFNOR confirmed to Cropwatch in March 2006 that they **do not have a standard for therapeutic grade essential oils (and neither do ISO)** and that they do not differentiate between Grade A and therapeutic grade essential oils. Further, essential oils have never been classified in grades described as A, B, C etc. and would surely not find any customers for grades less than A grade, even if they did exist! In any case, aromatherapy oils include minor essential oils, oils of differing geographic origins and specific chemotypes not covered by AFNOR or ISO standards whatsoever. We were further informed that AFNOR are writing to YLEO asking them to retract misleading statements wrt therapeutic grade oils, but the problem is that many hundreds of other oil traders also use these misleading terms.

As a further point of information, specifications for pesticides, heavy metals, dioxins, PCB's, MCP’s, radioactivity and other hazardous materials are not normally included in these standards, but we know for example, that it is possible for an oil that has been certified as ‘organic’ to contain low levels of background pesticides & other pollutants. Thus, if a company wanted to make the statement that it's oils are completely free from hazardous contaminants, then they would need to specifically test for them. This all goes to show that these existing standards do not meet specific aromatherapeutic requirements and there is no particular reason to suppose that they will do so in the future.

Update (2007): *Since the publication of our original article, it has come to our attention that although the paragraph quoted above is still featured on many YLEO – connected websites (e.g. at http://raindropkit.com/therapeutic.htm) it no longer appears at www.therapeutic-grade.com - a website run by Tom Anson of Anson Aromatic Essentials, an Independent Distributor of YLEO. Instead we find a page entitled "Setting the Record Straight Concerning AFNOR Correcting the misinformation perpetuated by some aromatherapy companies" http://www.therapeutic-grade.com/refs/afnor.html*

Cropwatch comments*: You might want to read Anson's statement, where he has educated himself with respect to AFNOR's status & activities. Whilst this is commendable, Anson still doesn't quite get it, since he doesn't seem able to completely let go of the concept of "therapeutic grade" and still has the YLEO wording "What is it that can make one oil a therapeutic-grade essential oil while another is Grade-A, but not therapeutic-grade?" Please note: there is* ***no such thing*** *as a Grade A oil! No official body defines Grade A essential oils – mainly for the reason that all offered essential oils should be Grade A – who would knowingly buy Grade B or C oils for a fragrance, flavouring or aromatherapy purpose?*

In an interesting development which Cropwatch is currently pursuing, we understand that YLEO's Director of Research and Development and Quality, a certain William F. Popin, managed to insert himself as chair of the USP Botanical Advisory Board**.** Cropwatch believes that this is an outrageous development, since there is no way that YLEO has any mandate to speak or sit in judgment for either the botanical or aromatherapy community. Further YLEO has elsewhere been heavily criticised for peddling essential oils on the basis of pseudo-science and hazardous practices, and we believe that Poppin therefore does not have the supported authority to retain this post (- supposing he's still in it). An initial communiqué from a USP official to Cropwatch (April 2006) indicated that the USP do not intend to define therapeutic/aromatherapeutic grades of essential oils, despite propaganda suggesting the contrary on YLEO-connected websites.

Conclusions.

1. Claims of therapeutic action of an essential oil should always be referenced. Aromatherapy educators owe it to their pupils and to the reputation of their profession to check the source of any claim and to make this source available Students in turn should request a source where none is given. Not doing this promotes the misconceptions further…

2. Independently check out what you are being told by essential oil traders and do not be put off asking for information that you are fully entitled to. The professional aromatherapist has a duty to be able to provide all relevant safety information to their clients and so It is in their interests to ask questions, require proof, request an MSDS, and have eyes wide open to marketing ploys.

3. Take in as many viewpoints as you can and always try to keep an open mind - there may not be any one 'right' way of looking at things but at least you'll have educated yourself across the range of available possibilities.

Good luck!

"In a time of universal deceit, telling the truth becomes a revolutionary act." George Orwell 1984.

References

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2.. Martin N. (2006) "The failure of aromatherapy. The effect of exposure to odour on the perception of pain." unpublished poster (private communication April 2006).

– see Frith M. (2006) "Smells a bit iffy: aromatherapy is nothing more than 'bunkum'." *Independent* 04.01.2006.

3. Jones, L. (1998) "Establishing standards for essential oils and analytical standards" *Proceedings of NAHA The World of Aromatherapy II International Conference and Trade Show* St. Louis, Missouri, Sept 25-28, 1998, p146-163.

§5. The Adulteration of Essential Oils - and the Consequences to Aromatherapy & Natural Perfumery Practice.

[Slightly updated from the original articles featured across 3 issues of the *Aromatherapy Times*, 2003-2004.]

Part 1. Essential Oil Adulteration

Introduction.

As far as adulteration is concerned, producers and distributors of essential oils are frequently painted as "the bad guys", but it should be pointed out that their essential oil customers frequently demand oils below the market price while still wanting to be told that they are authentic. In this climate, the honest oil trader may find it virtually impossible to survive on the margins he is allowed to make (over the last several decades many traders have gone bust). For example, in the late 20th Century, lavender oil (*Lavandula angustifolia*) was being sold almost as a loss leader by many French producers, as the market was unwilling to pay a realistic price. Currently, the aroma industry is dominated by a handful of large and powerful international houses whose corporate buyers often attempt to drive

raw material prices to impossibly low levels, not allowing workable profits to be made. This very fact sets the scene for unethical practices.

Essential oils - a definition.

An essential oil (e.o.) is the volatile oil containing odiferous elements of the plant, produced by steam or hydro-distillation of aromatic vegetable plant matter. E. o. components arise via the secondary metabolism of plants and are stored within specialised structures; ideally they are isolated with a minimum number of chemical changes from human intervention. Citrus oils, produced by the mechanical pressing of citrus peels, are also called essential oils, and, according to the International Standards Organisation (ISO), so are dry-distilled oils - such as cade oil (from the branches of *Juniperus oxycedrus*) and styrax pyrogenée (from *Liquidamber* spp).

E.o.'s should be produced by purely physical means, should be completely pure and 100% wholly derived from the named botanical source - but how are these standards to be guaranteed? No quality standards for the authentication of essential oils exist in aromatherapy, in spite of the revelations of gross adulteration of aromatherapy oils for retail sale (*Health Which* 2000). Professional aromatherapy organisations have failed to issue standards, in spite of individual schemes being put forward (Jones 1998) but, in contrast, other essential oil-using industries are served by the following standards:

The Pharmaceutical Trade: British Pharmacopoeia (BP) – the latest issued of which is the BP 2007 - is published on the recommendation of the Medicines Commission UK. Essential oil specifications are also published in the European Pharmacopoeia 5th edn, United States Pharmacopoeia (USP); & also the pharmacopoeia's of individual nations such as China, India etc. Earlier editions of The British Pharmaceutical Codex (BPC) contains many essential oil standards. still in use today.

Essential Oil Trade: Monographs on individual essential oils (EOA Standards) were produced by the Scientific Committee of the Essential Oil Association Inc.

Flavourings Industry: Food Chemicals Codex (the latest is FCC V) is produced at the request of the FDA (1992), is widely used for guidance by the food flavourings industry.

Aroma Companies: Many larger established Flavour & Fragrance Houses have their own internal purchasing standards.

Independent Certifying Bodies: International Standards Organisation (ISO Standards TC 54) & Association Française de Normalisation (AFNOR) both have detailed standards for individual e.o.'s.*

*An example is ISO 3515 for Oil of Lavender (2001) which includes minimum and maximum percentages of thirteen substances, and their occurrence in French (spontaneous and clonal), Bulgarian, Russian, Australian and 'other origin' lavender oils. Limits for lavandulyl acetate, for example, are set at 2.0-5.0% in Bulgarian lavender oil by the standard.

Aromatherapy

Whilst it is apparent that the current BP or ISO standards may serve the needs of particular industrial sectors, they do not entirely address the unique needs of the aromatherapy profession, since:

- Holistic aromatherapists demand that "pure" and "complete" oils are used, rather than oils only distilled for periods which are attractive economically, on an oil yield to fuel-consumption basis. Additionally, herbal essential oils with typically quick distillation times may have lower carbon-footprints that wood oils which require several days of distillation e.g. from endangered sandalwood & agarwood species.

- Many essential oils used in aromatherapy are particular to that profession, and not necessarily extensively used elsewhere e.g. oils of *Ravensara aromatica*, Rosemary oil verbenone chemotype, *Helichrysum italicum* ssp. *serotinum* etc.

As well as "pure and natural", the words "wild-crafted", "organic" and "therapeutic grade" are frequently over-hyped descriptor terms used by both aromatherapy and by "naturals" traders, which need more careful definition prior to professional endorsement.

Natural perfumery

Natural perfumers are other users of pure essential oils. Grimshaw (1989) discussed "purist" perfumers (who employ no chemically produced or chemically modified ingredients), but also discussed reasons why others may wish to use up to 50% synthetics in formulations. This was, in a way, a prediction today's situation, whereby **aromachology perfumes** (which enjoyed sales of £611 million for years 1999-2001 according to Mintel Database 2002) contain a proportion of synthetics stipulated by the perfume house, mixed in with the e.o.'s. The alleged psychopharmaceutical effects of these products still depend on the utilization of authentic essential oils in the formulation – as far as marketing claims/hype are concerned anyway. A realistic "in-practice" distinction between mass-marketed **aromatherapy perfumes** (as opposed to 100% e.o. blends) and aromachology perfumes, other than at a hypothetical level, has yet to be defined, since both commonly employ synthetics. The synthetics content can presumably have either symbiotic, neutral or opposing effects (mood changing etc.) to those claimed for the e.o.'s in the perfumes in question, hence the need for clinical testing of the finished formulations to support advertising claims.

Types of adulteration.

There are several distinct categories of adulteration:

1. Addition of single raw materials. This simple form of adulteration can be conveniently divided into two groups:

- "Invisibles" – i.e. those materials undetectable by a gas chromatograph (GC) analysis operating under routine set conditions ermployed to analyse essential oils.
- "Visibles – those materials which are normally detectable by GC.

"Invisibles": an example of this type is the deliberate addition of vegetable or mineral oil to essential oils (Nour-el-Din *et al*. 1977) - rapeseed oil in the EU is a particularly cheap vegetable oil which has been used for this purpose, whereas you might be unfortunate enough encounter palm oil in S.E. Asian products i.e. patchouli or vetiver oils. Theoretically the "total area" of the detectable components of the oil's gas chromatogram should be reduced by this latter type of adulteration, creating a suspicious situation for the analyst prompting the need for further investigation. These adulterant materials may be revealed by simple aqueous alcohol solubility tests, and their presence further verified by using a different GC column & operating conditions (to detect mineral oil), or by derivatisation (for example the use of a methylating agent to react with the vegetable oil – thereby creating volatile methyl esters of the fatty acid components of oil's glyceryl esters, which can be revealed by subsequent GC analysis).

"Visible" diluents in this context include a number of solvents and perfumery materials. It is an 'obvious', readily detectable & unsophisticated form of adulteration, but nevertheless the following have been found in commercial essential oils: in a few instances, resulting in a warning or prosecution by regulatory authorities:

Diluent	**Remarks**
Abitol (a primary hydroabietyl alcohol)	often used for extending resinoids.
Benzyl alcohol	Sensitiser; widely used in Asia at one time
Benzyl benzoate	Sensitiser, formerly widely used to 'extend' resinoids
Carbitol (diethylene glycol monoethyl ether or DEGME)	Widely used as food flavourings solvent
Diacetone alcohol	
Dipropylene glycol (DPG)	
Dipropylene glycol methyl ether (DPGME) and tripropylene glycol methyl ether (TPGME)	both of these substances are in air freshener technology.
Herculyn D™ (hydrogenated methyl ester of rosin)	
Isopar™	odourless kerosene fractions (often used as a candle perfume diluent)
Isononyl acetate	
Isopropyl myristate (IPM)	
Phthalate esters such as	DEP still occasionally found in

dibutylphthalate (DNP) or diethyl phthalate (DEP).	essential oils
Triacetin (the anti-fungal compound glycerol triacetate	popular food flavourings vehicle
3,3,5-Trimethyl-hexan-1-ol.	

Table 1. Diluents/extenders found in essential oils & resinoids as adulterants.

Use of other 'visible' materials like isotridecyl acetate (ITDA, Fixateur 404™), Herculyn D and Abitol, can be more difficult to spot in practice, because the materials may show a myriad of late-eluting small peaks on a GC trace representing their different constituent isomers, which could be overlooked by an inexperienced analyst, especially at low levels.

In all the above instances of "visible" and "non-visible" adulterants, the added material is merely a diluent, and makes no odour contribution of its own. Addition of 10-14% of such a material may pass un-noticed if the material is evaluated against a retained standard solely on an odour basis – even by an expert nose – but it will in all probability be revealed by subsequent physio-chemical testing e.g. added vegetable oil in patchouli oil can often be revealed by a standard solubility test in 90% ethanol at 20°C.

2. The addition of cheaper essential oils and adjuncts.

Blending-in cheaper oils to meet a customers' target purchasing price, or to make additional profit for the producer, is commonplace in the oil trade. Some practices mentioned by Arctander (1960) - for example, the practice of extending of Amyris oil (*Amyris balsamifera*) with Cedarwood oil Virginia (*Juniperus virginiana*) & Copaiba Balsam (*Copaifera* spp.) – are unlikely to fool too many potential customers in these present & more educated times, but other more common adulteration practices still remain, which include:

Essential oil	**Added essential oil adulterant**
Bergamot oil (*Citrus bergamia*):	addition of lemon oil, rectified ho oil (*Cinnamomum* spp.) and acetylated ho oil.
Bitter orange oil (*Citrus aurantium* subsp. *aurantium*):	(*Citrus aurantium* subsp. *aurantium*): addition of sweet orange oil (*Citrus sinensis*) & orange terpenes, plus trace amounts of character compounds.
Cedarwood oil Virginia (*Juniperus virginiana*):	addition of cedarwood oil Chinese (*Cupressus funebris*).
Cinnamon bark oil (*Cinnamomum zeylanicum*):	addition of cinnamon leaf oil.
Cinnamon leaf oil (*Cinnamomum zeylanicum*	addition of clove fractions, eugenol, cinnamic aldehyde etc.
Clove Bud oil (*Syzygium aromaticum*):	addition of clove stem oil & the isolates:

	eugenol & eugenyl acetate.
Fir Needle oils (*Abies* spp.):	addition of turpentine fractions, camphene, (-)-bornyl acetate etc.
Geranium oil Chinese (*Pelargonium* hybrids):	addition of adulterated Indian geranium oil (which itself has been known to contain diphenyl oxide!),
Grapefruit oil (*Citrus paradisi*):	addition of orange terpenes or sweet orange oil distilled + minor amounts of (+)-nootkatone & others
Lavender oil (*Lavandula angustifolia*):	addition of cheaper lavender oils (Chinese, Indian or Bulgarian to French lavender oil) lavandin (*Lavandula* x *intermedia*) oil varieties; the addition of spike lavender oil (*Lavandula latifolia*); the addition of ho oil rectified (*Cinnamomum* spp) and acetylated ho or acetylated lavandin oils etc.
Lemon oil (*Citrus limon*):	addition of orange terpenes, lemon terpenes & by-products (e.g. steam-stripped lemon oil). For lemon oil BP, expressed lime or grapefruit oil is added to poor grades to raise the UV absorbance level sufficiently to pass the BP specifications.
Nutmeg oil (*Myristica fragrans*):	the addition of nutmeg terpenes, α-pinene, limonene, turpentine fractions etc.
Patchouli oil (*Pogostemon cablin*):	addition of gurjun balsam (*Dipterocarpus* spp.); vegetable oils esp. palm oil, Hercolyn D; patchouli and vetiver distillation residues. The superior Indonesian patchouli oil is sometimes blended with cheaper Chinese oil patchouli oil.
Petitgrain oils (*Citrus* spp.)	addition of other citrus leaf oils & fractions, fatty aldehydes, linalyl acetate, orange terpenes etc**.**
Peppermint oil (*Mentha* X *piperita*):	addition of cornmint oil (*Mentha arvensis*).
Rosemary oil (*Rosmarinus officinalis*)	addition of eucalyptus oil *Eucalyptus globulus*) & especially camphor oil white (*Cinnamomum camphora*).
Sandalwood oil EI (*Santalum album*)	addition of West African sandalwood oil (*Osyris lanceolata*), West Australian sandalwood extract fractions (*Santalum*

	spicatum), sandalwood terpenes & synthetic sandalwood fragrance chemicals etc.
Tea tree oil Australian	addn of cheaper tea tree oil Chinese
Verbena oil (*Lippia citriodora*):	often *L. citriodora* herb distilled over lemon oil.
Violet Leaf absolute (*Viola odorata*):	addition of spinach absolute (*Spinacia oleracea*).
Ylang Ylang oil qualities (*Cananga odorata* subsp. *genuina*):	addition of cananga oil (*Cananga odorata*), ylang ylang oil tails etc., ylang ylang oil reconstitutions.

Table 2. Addition of cheaper essential oils as adulterants to named essential oils

And also addition of these synthetics to "convert" one oil to another:

Convert from x essential oil → y essential oil	**How?**
Basil oil exotic to Basil oil Sweet:	add linalol (Arctander 1960
Eucalyptus globulus oil to *Eucalyptus radiata* oil	add α-terpineol & others
Geranium oil Chinese to Geranium oil Bourbon:	addition of balancing materials monoterpene alcohols and esters, especially formates), copper chlorophyll (for colour) and frequently a trace of dimethyl and/or dibutyl sulphides.
Tangerine oil (*Citrus reticula* var. *tangerine*) to Mandarin oil:	addition of γ-terpinene, thymol, dimethyl anthranilate, α-sinesal & perilla aldehyde

Table 3. Addition of synthetics to 'convert' one essential oil to another.

3. The addition of cheap (nature identical) synthetics to oils that naturally contain these materials. Little detailed guidance has been previously published in this area. The older work of **Arctander** (1960) mentions a number of adulteration practices, but the sophistication of customer quality control procedures probably means that of the noted practices are now too obvious for today's market. Looking at other published material on adulteration, **Singhal *et al.*** (2001) remarks on the adulteration of spice oils by simple additions of single raw materials. e.g. the addition of synthetic citral to *Litsea cubeba* oil. My own guide to questionable practices includes the following:

Essential Oil	**Adulterant**
Anise oil (*Pimpinella* spp.):	addition of technical grade anethole
Basil oil exotic (*Ocimum* spp.):	addition of methyl chavicol & linalool

Benzoin resinoid (*Styrax* spp.):	addition of small amounts of vanillin, benzyl benzoate, ethyl & benzyl cinnamates, benzoic acid etc. to enhance odour (or to pass off cheaper "Sumatra" benzoin grades as "Siam").
Bergamot oil (*Citrus bergamia*):	addition of linalol and linalyl acetate.
Bitter almond oil (*Prunus amygdalus* var. *dulcis*):	addition of, or passing off benzaldehyde plus a few minor character compounds, as the oil.
Buchu leaf oil (*Barosma betulina* & *B. crenulata*):	addition to cutters of monoterpene sulphide fractions synthesised from the hydrogen sulphide treatment of pulegone, including *p*-menthan-8- thiol-3-one.
Cassia oil (*Cinnamomum aromaticum)*:	the addition of synthetic cinnamic aldehyde, methyl cinnamic aldehyde & coumarin**.**
Chamomile oil Roman (*Anthemis nobilis*):	addition of isobutyl angelate and synthetic bisabolols.
Cinnamon bark oil (*Cinnamomum zeylanicum*):	the addition of synthetic benzaldehde, eugenol and cinnamic aldehyde.
Citrus oils:	the addition of formulations of fatty aldehydes, monoterpene alcohols & monoterpene esters to terpeneless and folded citrus oils.
Caraway seed oil (*Carum carvii*):	the addition of limonene and (+)-carvone
Cardamom oil (*Elletaria cardamomum*):	addition of linalyl acetate, 1,8-cineole and α-terpinyl acetate.
Celery seed oil (*Petroselenium crispum*)	the addition of limonene + touches of alkyl phthalides.
Cognac oil:	Addition of ethyl esters of aliphatic acids e.g. ethyl oenanthate.
Coriander seed oil (*Coriandrum sativum*):	addition of linalol and trace amounts of certain pyrazines. NB price fluctuates – not always economic!
Cypress oil (*Cupressus sempervirens*):	addition of α-pinene, δ-3-carene & myrcene.
Cumin seed oil (*Cuminum cyminum*):	addition of cuminaldehyde and others.
Dill seed oil (*Anethum graveolens*):	addition of α-phellandrene & limonene
Elemi oil (*Canarium luzonicum*):	addition of α-phellandrene & limonene.
Galbanum resinoid (*Ferula galbaniflua*):	addition of β-pinene, undecatrienes & others.

Garlic oil (*Allium sativa*):	addition of aliphatic sulphide mixtures containing 2-propenyl disulphide, 1-propenyl disulphide etc
Geranium oils (*Pelargonium* hybrids):	the addition of *laevo*-citronellol & geraniol
Jasmine absolute (*Jasmimum* spp):	synthetic reconstructions frequently added.
Juniper oil (*Juniperus communis* var. *erecta*):	addition of terpene hydrocarbon mixtures containing α-pinene & δ-3-carene, also Juniper branch oil and second grade oils from spoiled Juniper berries.
Labdanum resinoid (*Cistus landiferus*)	formerly, the addition of DEP (now discontinued) or Abitol, with small amounts of ambroxan and *p*-methyl acetophenone to enhance odour.
Lavender oil, spike (*Lavandula latifolia*):	addition of eucalyptus & white camphor oil fractions, Spanish sage oil etc.
Lemongrass oil (*Cympogon* spp.):	addition of synthetic citral.
Litsea cubeba oil:	the addition of synthetic citral.
Mentha citrata oil:	addition of linalol + linalyl acetate.
Mustard oil (*Brassica nigra* & *B. juncea*):	synthetic allyl isothiocyanate is passed off as the oil (which is used in flavourings, but is banned in perfumery).
Neroli oil (*Citrus aurantium* subsp. *aurantium*):	reconstructions frequently added to, or passed off, as the authentic oil.
Origanum oil (*Origanum* spp.):	addition of *para*-cymene and carvacrol.
Onion oil (*Allium cepa*):	addition of synthetic aliphatic sulphide mixtures.
Palmarosa oil (*Cymbopogon martinii* var. *motia*):	the addition of geraniol.
Petitgrain oil Paraguay (*Citrus aurantia* subsp. *aurantium*	addition of admixture of linalol, linalyl acetate, α-terpineol, geranyl & neryl acetates & trace amounts of pyrazines etc.
Pine needle oils (*Pinus* spp.):	addition of (-)-bornyl acetate, isobornyl acetate, (-)- limonene, α-pinene, camphene etc.
Rose oil (Rosa spp.):	reconstructions using damascones, β-ionone plus (-)-citronellol and other rose alcohols, plus rose steroptenes. Occasionally adlterated with β-phenylethyl alcohol, rhodinol fractions and cheaper rose oils (Morocco,

	Crimea etc.).
Rosemary oil (*Rosmarinus officinalis*):	addition of camphor, isobornyl acetate (+ *Eucalyptus &* turpentine oil fractions).
Rosewood oil (*Aniba* spp):	addition of linalol, plus trace amounts of methyl heptenone, methyl heptenol, 3-octanol, *para*-methyl acetophenone etc.
Spearmint oil (*Mentha spicata*):	addition of (-)-carvone
Vetiver oil acetylated (*Vetivera* spp):	addition of cedrenyl acetate.
Wintergreen oil (*Gaultheria procumbens*):	the adding of, or the passing off of synthetic methyl salicylate, as the oil.
Ylang ylang oil (*Cananga odorata* var. *genuina*):	addition of benzyl acetate, methyl benzoate, para-cresyl methyl ether, geranyl acetate, benzyl benzoate, benzyl cinnamate, cedarwood oil and others or complete reconstitutions/bases.

Table 4. Commonly added chemical adulterant chemicals to essential oils

Boelens (1997) described four types of odourants in essential oils: character compounds, essential compounds, balance compounds and artifacts. Adulterants such as monoterpene hydrocarbons, being balance compounds in Boelens scheme above, do little for the characteristic odour of the cut oils, since the added materials have little odour value in themselves. In practice, the addition of certain adulterants "flattens" the odour profile of the authentic oil, or otherwise dilutes or represses some true character, sparkle and richness. To compensate for this, a practiced oil counterfeiter will add small amounts of character compounds. Taking the example of Cypress oil *Cupressus sempervirens* var. *stricta*, the oil is often adulterated by the addition of the monoterpene hydrocarbons α-pinene and δ-3-carene, which creates a crude terpinic aspect. The addition of a small amount of deca-2-(*E*),4-(*Z*)-dienyl isovalerate to the somewhat insipid cutting agent, will give a better impression of the oil's normal character, a lead which follows on from the work of Garnero *et al*. (1978) who identified the compound above in cypress shoots, and found it strongly reminiscent of the typical odour of cypress oil.

Commercial oils, adulterated by such synthetics, can often fool the less sophisticated nose, or satisfy those oil customers buying to a price, where authenticity is sometimes not a primary consideration. Depending on exact market conditions, some oils have a selling price which is so cheap that it is generally unrewarding for a trader to reconstitute, or even add, nature identical aroma chemicals, to the product, except for some solvent-like diluents. This category would include the following oils:

Essential oil	**Remarks**

Camphor oil white (*Cinnamomum camphora* fractions)	
Citronella oil (*Cymbopogon* spp.)	- although the oil has been known to have been crudely adulterated with dipentine and citronella terpenes
Clove leaf oil & stem oils (*Syzygium aromaticum*)	
Cornmint oil (*Mentha arvensis* subspp)	
Eucalyptus globulus oil	
Sweet orange oil (*Citrus sinensis*)	- although could be adulterated with orange terpenes
Tea tree oil (*Melaleuca altenaria*)	although through the economies of larger scale, it may be profitable to add terpinen-4-ol and α- & γ-terpinenes; but up until recently they have been as expensive as the essential oil.

Table 5. Essential oils normally uneconomic to adulterate

Other oils may be difficult to reconstitute with anything other than diluents because the major components are not commercially available; as is the case with patchouli oil & vetiver oils. .

4. The addition of isolates or natural components to essential oils e.g. the addition of pure natural eucalyptol ex *E. globulus* oil (*Eucalyptus globulus*) to rosemary oil (*Rosmarinus officinalis*) or rectified ho oil (>99.5% (-)-linalol) to lavender and bergamot.

5. The addition of bases or reconstituted essential oils to genuine oils & absolutes. It is particularly economically attractive to extend high value floral absolutes such as rose (*Rosa* spp.), jasmin (*Jasminum grandiflora* other spp.) and osmanthus (*Osmanthus fragrans* var. *auranticus*), and the more valuable oils such as neroli oil and rose otto, and this practice occurs extensively within the trade.

6. The addition of individual unnatural components to oils and aromatic raw materials.
Absolutes have been traditionally produced for the consumption of the perfumery industry, but are being increasingly employed in aromatherapy (in spite of using un-natural solvents in their manufacture). Revelations that materials such as Linden Blossom absolute (*Tilia* spp.) contain hydroxycitronellal, or that Gardenia absolute (*Gardenia* spp.) has added styrallyl acetate, or that added Schiff's bases have been found in floral absolutes, should not therefore come as a complete surprise. It has been suggested that if the synthetic fragrance compound is added in to the aromatic plant material during manufacture, the added material will "blend in" better. In other instances, absolutes may well

contain perfume bases or reconstitutions, rather than a single key character compound.

7. The addition of "normal" oils to oils certified as "organic".

Many certifying bodies (EcoCert, Soil Association) seemingly rely on inspection regimes, batch tracking and the separate & secure storage of organic oils, rather than independently analysing finished oils for pesticide levels, a situation inviting abuse by unscrupulous traders. There is also the huge question of "who inspects the inspectors", the lack of external expert input into their protocols, and the denial of free public access to the records of these bodies – but these topics (and many others) are another issue! The labeling laws seem so lax in the EU, that an advertising claim on a bottle, such as "contains organic orange oil" would not invite prosecution if the oil contained 0.1% organic orange oil and 99.9% non-organically produced orange oil – and who, specifically, is charged with checking anyway, and who has the necessary expertise? Further, it has been revealed that on more than one occasion, oils from endangered species have been about to be certified as "organic" by one particular organisation with seemingly little eco-awareness, and with little experience of complexities of the oil trade (Wildwood 2002), to which the president of the association concerned is reported to have replied that certification is "…bound to be an evolving process, very often in uncharted territory". And so many of us "at the coal-face" feel that the whole organic oils exercise, although possibly very noble in its intent, is not particularly watertight.

8. Passing off one essential oil as another.

"Old chestnuts" in this category include the following deceptions:

Essential oil	**Passed off as…**
Cinnamomum camphora (var. cineole type) fractions (1,8-cineole rich)	*Eucalyptus globulus* oil by certain Chinese suppliers in early 1998. Cineol rich fractions from *Cinnamomum longepaniculatum* may be used for the same purpose.
Cornmint oil from *Mentha arvensis* var. *piperascens*	peppermint oil *Mentha* x *piperita.* Chinese and Brazilian "peppermint oils" do derive from *M. arvensis* / subsp.).
Melissa oil (*Melissa officinalis*)	frequently concocted from mixtures of / fractions of, Citronella oil, *Litsea cubeba*, lemon oil (*Citrus limon*) and various other isolates & synthetics.
Oils of *Micromeria fructicosa* (Turkish pennyroyal) & *Hedeoma pulegioides* (American pennyroyal)	have been passed off as pennyroyal oil (*Mentha pulegium*).
Treemoss resinoid (*Pseudoevernia furfuracea*)	passed off as or use as an extender for Oakmoss resinoid (*Evernia prunastri*)
Petitgrain oil terpeneless (*Citrus*	has a former tradition of being passed

aurantium subsp. *aurantium*)	off as rosewood oil (*Aniba* spp.). Petitgrain oil Paraguay may be passed off as petitgrain oil bigarade.
Sweet orange oil Brazil	has been consistently passed off in former times as the finer Sweet orange oil Florida.
Star anise oil *Illicium verum*	has been passed off as anise oil (*Pimpinella* spp), & synthetic anethole is passed off as star anise oil (esp. in certain anise type liquors!).
Tolu balsam (*Myroxylon balsamum* var. *α-genuinum*..):	some aroma concerns are honest enough to acknowledge that the commercial products offered as tolu qualities are not genuine (Biolandes 1997), offered products often being blends of *Styrax* spp. and aroma chemicals etc.

Table 6: Essential oils commonly passed off as other essential oils.

…. and three additional categories which are arguably more about "contamination" than adulteration:

9. Co-gathering one species with another.

This may be deliberate or accidental, and might arise through lack of botanical education of the involved gatherers, especially those involved in "wild-crafting".

Species	**Co-gathered with – remarks.**
Artemisia mesaltantica ("Blue Armoise") and *A. atlantica* growing in Morocco	often co-gathered or deliberately passed off as Moroccan Armoise oil (*A. herba-alpa*). However the situation is further complicated by the fact that there are at least four chemotypes of *A. herba-alpa* (!) according to Richard *et al.* (1984).
Litsea cubeba	*Litsea enosma* & *L. mollifolia* as well as other *Litsea* species are used to produce the oil of *Litsea cubeba* according to Zhaobang (1995).
Massoy essential oil (from bark of *Cryptocarya massoy*),	Joulain (1994) reports that bark has been frequently been gathered with the bark of other species in the past (which in the case of bark from *Cinnamomum* spp., might contain high levels of safrole, of toxicological concern).
Nardostachys grandiflora	said to be often co-gathered with *Valeriana wallichi* according to Traffic

	International (1999) and that published chemical compositions of essential oils from these species are similar – see http://www.cropwatch.org

Table 7 Commonly co-gathered species during harvesting of certain aromatic crops.

10. GM-Free Essential Oil Production Methods.

Many EU oil-buying customers require oils to have been produced by plants free of gene modification, or free of Genetically Modified Organisms (GMO's) themselves, and to be free of their use, and use of their derivatives during manufacture, according to Commission Regulations 50/200, 1139/98, 90/220/EEC and 2092/91/EGW Biological Agriculture. Certificates to show that plant material was polymerase chain negative may need to be provided by suppliers to prove GM-free status.

11. Oils produced from non-irradiated vegetable sources.

Many essential oil customers require oils certified as being manufactured from non-irradiated sources at any point of the production process, in order to comply with EU Directives 99/2/EC and 99/3/EC, and so may require statements that the original oil-source vegetable raw material, (including spices), have not been gamma-ray irradiated. Suitable sources of γ-radiation ate usually taken to be cobalt-60, caesium-137 and electron/X-ray irradiation from an electron accelerator. It is of note that certain terpene compounds are changed by irradiation – Kawashima K. (1981) found that α-terpinene, γ-terpinene and terpinolene levels drop at a dose of 7.5 kGy, whilst other spices such as cardamom and coriander change flavour attributes at the same dose Bachman & Gieszcznska (1973). Rapid tests are now available to establish irradiation status - cumin seeds for example can be subjected to the rapid detection method for γ-irradiation, developed by Satyendra *et al.* 1988.

Spotting adulteration.

Odour evaluation.

A trained perfumer or essential oils analyst might immediately spot a QC problem with an oil sample before committing the oil to more sophisticated analytical tests – in fact the e.o. may simply be rejected on a poor or uncharacteristic odour profile. So, in spite of great technological advancements in analysis techniques (sometimes bordering on scientific imperialism), the trained nose can still be the single most important arbiter of quality, and it is important to keep sight of this fact.

Analytical procedures.

Quality control procedures for essential oils in aromatherapy have already been (briefly) discussed by Garnero (1999).

Physiochemical methods.

These standard tests have long been used to help establish the identity of oil, on the basis that normally produced genuine oils have characteristic values for:
Specific gravity/ Relative density
Refractive index
Optical Rotation
Tests are normally carried out at ambient temperature (20°C or 25°C) if the oils are normally liquids at this temperature; guiaicwood oil (*Bulnesia sarmienti*) & rose otto (*Rosa* spp.) etc., are normally solid in temperate climes at ambient , and may be evaluated at 40°C.

Essential oils are sometimes traded on the basis of "USP figures" or "BP figures". This means that the oils conform the relevant specifications in spite of synthetic additions, but obviously do not conform to the "100% wholly derived from the named botanical source" requirements of the pharmacopoeia monographs.

Chemical tests.

[The first two tests are indicative of contamination rather than adulteration, but are included as examples of requirements in sister industries].
Heavy metals – in essential oils used as food flavourings, a limit of 3mg/Kg arsenic, 10mg/Kg lead, 1mg/Kg cadmium and 1mg/Kg mercury is imposed under Council Directive 88/388/EEC.
Pesticides - this is a troubled area. Buchbauer (1998) reports that Schiler and his team at the free University of Berlin found levels of 34 organochlorine pesticides in 72 of 110 commercial essential oils tested, but in reality the exorbitantly high costs of testing for pesticides (dedicated equipment, trained operators etc.) often do not square realistically with the economic resources available to e.o. producers and suppliers. This situation is further driven by requirements in EC directives for food/feed ingredients, and often puts companies in as Catch-22 situation of potentially loosing potential e.o. flavourings business, or falsifying information to the customer.
Acid value
Ester value, saponification values etc – these wet chemical tests are now largely superceeded by more accurate techniques e.g. high performance capillary GC or GC/MS.

Instrumental methods.

Suitable combinations of instrumentation used to spot adulteration include:

GC-MS
GC-FTIR (Fourier transform Infra-Red)
GC-^{13}C NMR (Nuclear Magnetic Resonance -see Kubeczka & Formáček 2002)
HPLC-MS.

Whilst these techniques are undoubtedly useful, the cost of trained operator time and the necessary allocation of sophisticated & expensive hardware for the time-consuming methodology and number crunching capabilities, all for what is essentially a basic QC task asking a question "is this material genuine or not?", is often seen as inappropriate by aroma company management. Less capital intensive techniques therefore might be deemed more practical and appropriate, and nowadays, it might be considered that minimum equipment ("entry level") for oil authentication work would be a GC/MS facility and access to chiral chromatography techniques.

Thin layer chromatography (TLC). This technique requires a less capital-intensive investment, and for example is a requirement for essential oil testing (in conjunction with a battery of other tests), in the BP monograph (2007) on Citronella oil (*Cymbopogon winterianus*), amongst others. The monograph requires identification of the oil by TLC and gas chromatography (reference chromatogram with identified compounds is supplied, the test oil results must be within prescribed limits), as well as requiring prescribed physio-chemical testing.

In another area, TLC has been used to identify the geographical origins of olibanum resins (Harefield 1984).

Fingerprints.

A slightly older review of the value of "fingerprints" in e.o. analysis is given by Lamparsky (1987), the subject of which centres on: pattern recognition of GC traces of e.o.'s, examples of character compounds (which Lamparsky terms impact compounds) and unique components of certain oils, as well as the enantiomeric analysis technique (see below). Nowadays, GC analysts have the additional resource of commercial available MS libraries, which compare the spectrum of each compound detected with a library of reference spectra, identifying the closest matches, and giving a confidence level estimation of each tentative identification.

Marker Compounds.

Many oils have unique or unusual marker compounds, which can be used as standards of authentication, such that some essential oil customers will only purchase oils conform to certain stipulated limits for these marker compounds. An introduction to this topic is given by Teissaire (1987). The table below gives a few analytical hints:

Essential Oil	Examine for:	Indications
Anise oils	γ-himalchene, pseudoisoeugenyl 2-methylbutyrate and foeniculum.	To distinguish between *Pimpinalla anisum* and *Illicium verum.*

Anise Oil (*Illicium verum*)	*cis*-anethole	Levels >0.5% may indicate addition of synthetic anethole.
Anise oil (*Illicium verum*)	Anisic alcohol & anisic aldehyde	Levels >0.7% may indicate excessive oxidation.
Artemisia vulgaris	Vulgarone	Authenticity indicator.
Cinnamon bark oil & Cassia oils (*Cinnamomum* spp)	Absence of 5-phenyl penta-2,4-dienal.	Impurity in added synthetic cinnamic aldehyde
Geranium oil (N. African type)	(-)-(4R)-6,9-Guiadiene; 10-epi-γ-eudesmol.	Authenticity indicators
Lavender oil (*Lavandula angustifolia*)	α-Santalene, (-) -lavandulol, (-) -lavandulyl acetate etc.	Authenticity indicators
Lemon oil, Mandarin oil etc. (*Citrus* spp.)	δ-3-Carene	Its virtual absence (<0.01%) might indicate that no orange oil or orange terpenes adulterants have been added .
Patchouli oil Indonesian (*Pogostemon cablin*)	α-Gurjunene	Concentration found is proportional to concentration of added gurjun balsam.
Patchouli oil Indonesian (*P. cablin*)	Patchulol	Range 26-40% for authentic oils.
Rosewood oil (*Aniba* spp)	Eremophilene	Authenticity indicator
Rose otto (*R. centifolia*)	(*Z*)-9-nonadecene	Authenticity indicator in steroptene fraction of rose otto in which it allegedly occurs at fairly constant levels*

Table 8: A few analytical hints for essential oil examination.

*according to Ohloff and Demole

For oil authentication, analysts sometimes rely on estimation of the concentrations of non-commercially available e.o. components, which would be reduced from their normal concentration by the deliberate addition of adulterants. For example celery seed oil naturally contains a certain level of β-selinene;

addition of adulterants such as orange terpenes would reduce the concentration of β-selinene to below acceptance range criteria.

Spotting minor impurities in adulterants by GC.

The GC can be employed to detect the presence of synthetic additives to essential oils from tell-tale impurities in the synthetics themselves. Added natural camphor in oils such as Rosemary and Sage may be detected by the presence of impurities such as α-pinene, camphene, β-pinene, cineole, fenchone, fenchol, camphene hydrate and methylcamphenilol (BP 2002). Similarly in rosemary, fir needle and pine needle oils, the presence of added borneol may be detected by examination of borneol: isoborneol ratios, or (-)-bornyl acetate by looking at bornyl acetate: isobornyl acetate.

Impurities in synthetic linalol made via the older acetylene or β-pinene routes (e.g. dehydrolinalol, dihydrolinalol, tetrahydrolinalol, plinol & others), don't occur naturally in linalol-containing essential oils such as lavender (*Lavandula angustifolia*). Therefore the presence of dehydrolinalol etc, used to be relatively easy way of identifying synthetic linalol in a lavender oil GC chromatogram. Nowadays, cleaner linalol can be manufactured via the α-pinene process and its' presence in oils is less easily detectable. Cheaper grades containing impurities are still employed however, so that in cheap linalyl acetate (which is derived from linalol), it is still often possible to detect traces of, dihydrolinalyl-, pinanyl- or plinyl acetates, thus giving away its' origin.

Enantiomeric analysis.

Essential oils invariably contain substances with one or more asymmetric carbon atoms, which give rise to different optical isomers (enantiomers). The distribution ratios of these different enantiomers (as determined by GC using chiral columns) can be used as a powerful tool to detect oil adulteration by nature-identical synthetics. A review of enantioselective GC analysis is provided by Mosandl (1998); uses of enantiomeric analysis in establishing lavender oil authenticity is reported by Kreis and Mosandl (1992) and for bergamot oil by Cotroneo *et al.* (1992). A few of examples of specific oil constituents showing high levels of optical purity include:

Essential Oil	Enantiomeric Ratio	Enantiomeric excess	Reference
Bergamot oil: (*Citrus bergamia*)	(4R)-(-)-linalol to 100%; (4S)-(+)-linalol 0%.	100	Cotroneo *et al.* (1992)
Fennel oil (*Foeniculum vulgaris*)	(4R)-(+)-α-phellandrene 100%; (4S)-(-)-α-phellandrene 0%	100	Cassiabanca (1996)
Ho leaf oil (*Cinnamomum*	(4R)-(-)-linalol 96.2%; (4S)-(+)-linalol 3.8%	92.4	Bernreuther & Schreier

spp)			(1991)
Lavender oil (*Lavandula angustifolia*)	(4R)-(-)-linalyl acetate >99%; (4S)-(+)-linalyl acetate <1.0%	98 +	
Lavender oil (*Lavandula angustifolia*)	(4S)-(+)-linalol usually <5% but up to 15% during very prolonged hydrodistillation. Over 15% of 4S-(+)- linalol indicates adulteration with racemic linalol	85 (worst case) 95 (normal)	Kreis & Mossandl (1992)
Melissa oil (*Melissa officinalis*)	(3R)-(+)-methyl citronellate 99.0%; %; (3S)-(-)-methyl citronellate 1.0%	98	Lawrence (2000)
(Synthetic linalool)	(4R)-(-)-linalol 50.0%; (4S)-(+)-linalol 50.0%	0	(Supplier info)

Table 9. Enantiomeric information on some essential oils.

Certain of these optical purity figures may be useful in spotting the addition of synthetic racemic adulterants (such as linalol), but obviously the addition of racemic ho leaf oil to bergamot or lavender oil may be harder to spot on this basis alone, due to the similarities in optical purity of the constituent linalol. Dugo (2001) discusses enantiomeric techniques for the differentiation of citrus oils, as summarised in the table below:

Essential Oil	Can be differentiated from:	On the basis of the enantiomeric ratios of:
Bergamot oil	Lemon oil	Linalol
Bergamot oil	Mandarin oil	β-Pinene, sabinene, linalol
Bergamot oil	Sweet orange oil	Sabinene & limonene
Lemon oil	Mandarin oil	β-Pinene, sabinene, limonene, linalol
Lemon oil	Sweet orange oil	Sabinene & limonene
Lemon oil	Bitter orange oil	Linalol
Mandarin oil	Sweet orange oil	Sabinene & limonene

Mandarin oil	Bitter orange oil	β-Pinene, sabinene, linalol
Sweet orange oil	Bitter orange oil	Sabinene & limonene

Table 10. Differentiation of Citrus Oils by Enantiomeric Distribution of Certain Volatiles, after Dugo *et al.* (2001).

Isotopic analysis.

Measurements of ratios of ^{12}C:^{13}C distribution by natural isotope spectrometric methods, or by isotopic analysis of the ^{12}C:^{13}C ratios in pyrolytic CO_2 are mentioned by Lawrence (2000) as two of six possible ways to determine the natural and genuine status of e.o. components. ^{2}H:^{1}H site specific natural fractionation of single components represents a third possible way in Lawrence's scheme, and this technique is explored for essential oils containing linalol and linalyl acetate by Hannaguelle *et al*. (1992). Hener (1992) maintains that the combination of enantioselective GC together with stable isotope ratio analysis is a powerful tool for this purpose of establishing the 100% natural status of an aromatic raw material. The expense of these techniques, however, surely limits their more universal application, although Schmidt *et al.* (2001) report that isotopic analysis has become an important tool in flavourings for checking the natural status of ingredients such as benzaldehyde and vanillin.

Component ratios.

This technique relies on the tendency of specific components to adhere to given set of component ratios in given e.o.'s oils, which can be determined by simpl GC or GC/MS analysis. For example Lawrence (1997) provides twelve component ratios for Midwest Native Spearmint oil (*Mentha spicata*) against which unauthenticated oils of that type may be compared. In an earlier article on the same theme, Shu & Lawrence (1996) examined samples of peppermint and Indian lemongrass oils, and claim to show, in the case of the Indian lemongrass oil examination, that since the component ratios of the examined oil fall between that of E. Indian and W. Indian lemongrass oils, that the oil must have been adulterated. In general terms, this technique is useful and well within the ability and budget of the average commercial oils analyst.

Background note – the situation in other trades using essential oils:

As regulatory requirements in essential oil trading become more demanding, many essential oil buyers buying oils and oleoresins which conform to food grade or cosmetics regulations requirements items may now require a number of signed supplier certificates. These many relate to allergenic properties, GMO-free production, monochloropropandiol content, pesticide levels etc. Certificate of Naturalness fulfilling the requirements of European Directive 88/388/EC assures that oils are produced by purely physical means (steam distillation, separation of oil from distillation waters by gravity etc.) and that no additional chemicals (other than water) are used in the manufacture of these products. Information on the addition of any other components (such as anti-oxidants BHA/BHT or

tocopherols, colourants, residual solvents according to CPMP/ICH/283/95 etc) may also be requested.

In other areas, customers may require information on dioxin or dioxin-like PCB's, heavy metals, polyaromatic nuclear hydrocarbons etc. etc. to determine that the material complies with EC Regulations. . A more up-to-date summary of some of these regulatory requirements can be found at http://www.cropwatch.org/cropwatch14.htm.

Part 2.
The Consequences of Adulteration to Aromatherapy & Natural Perfumery Practice.

Background.

Aromatherapists and natural perfumers have long required that their e.o.'s are genuine, but conversely, the essential oil trade has traditionally offered oils to the perfumery and flavourings trades on a "buyer beware" principle. Therefore, the finding in the *Which Health* report (*Health Which* 2001) on aromatherapy oils, citing a case where a labelled sandalwood oil turned out to be a synthetic sandalwood aroma chemical, cannot come as a complete surprise.

Whilst many e.o. used in aromatherapy are sourced from commercial oil trade outlets, other items are offered by smaller dedicated aromatherapy oil producers. In attempt to make themselves uniquely positioned in the oil market, aromatherapy oil suppliers have previously boasted that their oils are distilled longer and under gentler conditions to produce superior oils. This is a complete nonsense – longer treatment can only encourage greater artefact production via thermal degradation, and any perceived more pleasing odour effect is possibly due the increased oil complexity (via the creation of artefacts). Even more curious is the easy acceptance of hype that CO_2 extracts are suitable for the aromatherapy community. In many cases the CO_2 extracts are of unknown composition and toxicity, extractions are not standardised (depending on operating conditions CO_2 extracts can resemble either resinoids or essential oils, and all stages in between) and the use of any co-solvents during processing is often omitted by suppliers. Furthermore the concentration of pesticide residues during the CO_2 extraction of spices are from seven to fifty three times greater than the values obtained by use of conventional solvents, according to Guba R. (2002).

Consequences.

The adulteration of essential oils leads to the following concerns:

1. Toxicity of the adulterant(s).

Phthalates such as DEP are still occasionally found as adulterants in essential oils. Phthalate esters have been withdrawn as ingredients by many cosmetics manufacturers on toxicity grounds; specific phthalates (DEHP & DIOP)

are classified by the EU as reproductive toxicants. Whilst consumer pressure groups campaign for awareness in this area (see for example: http://www.nottoopretty.org/); the other side of the argument can be viewed on http://cms.phthalates.com/index.asp?page=3.

Traces of residual organic solvents (such as hexane and cyclohexane) in oils and absolutes are found as a result of extraction & co-distillation practices.

The presence of pesticides in tainted e.o.'s in cosmetics has been described as a serious health & safety issue by Buchbauer (1998); their inevitable presence in aromatherapy oils is an unresolved issue.

2. The interference of adulterants on the expected physiological or psychophysiological effects of the essential oil.

Point 2 above has long been a concern of aromatherapists, but proof of adverse effects has been harder to find, although the following section below might furnish the beginnings of a case:

Chiral Issues from added adulterants.

Addition of racemic synthetics to natural essential oils may distort the enantiomeric ratios of the naturally occurring substances within the make-up of oils, and thus may have an untoward effect on the expected physiological outcome. The logic behind this may be predicted from data accrued on the contrasting physiological effects of different chiral isomers of the same substance. A few examples are given below:

Huenberger *et al*. (2001) have demonstrated that inhalation of (+)-limonene caused increases in systolic blood pressure and changed alertness and restlessness in subjects, whereas (-)-limonene only affected blood pressure.
(-)-Carvone was reported to increase pulse rate, diastolic blood pressure and restlessness whereas (+)-carvone increased systolic and diastolic blood pressure. Traynor (2001) reports that when evaluated by Contingent Negative Variation, (+)-rose oxide confers relaxing physiological effects, whilst (-)-rose oxide (which occurs in Bulgarian Rose oil and geranium oils) possesses a significantly higher simulative effect.

Sugawara *et al.* (2000) looked at the effects of 10 mins inhalation of the different linalool isomers [(-)-linalol purifed from lavender, (+)-linalol from coriander, and synthetic (+/-)-linalol] inhaled before and after work. Effects were examined by sensory scoring and portable forehead surface EEG measurements. They found inhaling (-)-linalol after hearing environmental sounds produced a more favourable impression produced a more favourable impression in the sensory test but was accompanied by a greater decrease in beta waves after than before work. Conversely with mental work, there was a tendency for agitation accompanied by an increase in beta waves. (+/-)-Linalol gave results similar to

(-)-linalol, but (+)-linalol gave the reverse results.

Buchbauer (1998) maintains that each constituent of an essential oil contributes to the beneficial or adverse effects of the oil. I contend that changing the distribution of chiral components of oils by deliberate adulteration with racemic synthetic odourants may in fact change the properties of the oil.

Glossary.

Adulteration: the purposeful addition of cheaper alternative oils, oil fractions, by-products, isolates, natural or non-natural synthetics etc., to reduce the cost price of the oil.

Aliphatic*:* a series of compounds built up from carbon backbones with the specific formula C_nH_{2n+2}.

Bases (perfumery): complete accords/compositions added to fragrances to form part of an entire note e.g. rose base, jasmin base, etc. May not always be as complex or true to nature as reconstituted oils

Buyer Beware: the operating policy whereby an essential oil or other raw material is offered to a customer without guarantees, and the onus is on the customer to assess it's purity or status.

Chiral compounds: the ability of a specific substance, containing one or more asymmetric carbon atoms, to occur as 2 or more optical isomers (**enantiomers**). These chiral components may have different odour profiles e.g. (-)-carvone is minty, (+)-carvone is caraway-like.

Coeur: heart or body of a fragrance or raw material.

Commercial essential oils: essential oils available in quantity, which it is understood, are not necessarily pure.

Compound: an aroma industry term for a fragrance mixture, often with more components than a blend, and liable to comprise (mainly) synthetics. Do not confuse with substance!

Coupage: (in this context) an amount of extender added to an essential oil.

Extender: an agent (single or compound) used for the purpose of adulterating or extending an oil.

Extending: a term for adulteration almost implying a degree of legitimacy.

Isolate: a specific fraction of an essential oil. May be composed of a single chemical e.g. eugenol from Clove oil.

Oil blend: a (hopefully) harmonious mixture of essential oils.

Organic oil: a more expensive essential oil, which has been derived from vegetable matter which has been grown in a pesticide free environment, but which still liable to have a pesticide content reflecting background contamination/incorporation.

Sophisticating an oil: a scientifically inappropriate trade term for extending or adulterating an oil.

PQ quality: A slightly older expression, standing for "Perfume Quality" i.e. not necessarily pure, but the odour profile should strongly remind of the named oil, and the performance in product should be satisfactory.

Reconstituted oil: An oil made from nature identical synthetics, to look like analytically as far as possible -, and to give an accurate odour impression of -, the named essential oil.

Abbreviations Glossary.

(-)- laevorotatory isomer
(+)- dextrorotatory isomer
BP British Pharmacopoeia published by the Pharmaceutical Press.
DEP Diethyl phthalate
EC European Community
EU Economic Community
EO essential oil
EI East Indian
GC gas chromatography
GC/MS coupled gas chromatography with mass spectroscopy
ISO International Standards Organisation
TLC Thin layer chromatography
WI West Indian
USP United States Pharmacopoeia

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