Toxicity Myths: the Actual Risks of Essential Oil Use

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Amongst the wide variety of aromatherapy books and periodicals available today, we find many recommendations regarding the safe, therapeutic use of essential oils. Such recommendations are often contradictory and seldom supported by either references, research or actual clinical experience. Because of this, it is important to explore the range of warnings and advice, addressing the validity of each. It is also important to study the underlying assumptions and reasoning underlying unresearched statements.

I have personally been involved in the both the practice and the business of aromatherapy since 1986, when I arrived in Australia. Having always approached the therapeutic use of essential oils from the "radical" French "aromatic medicine" perspective, I have long noted the many incongruous and exaggerated statements regarding essential oil toxicity. Since that time, through my involvement with various government and industry bodies, I have focused on the topic of essential oil toxicity as necessary area of study. This, given the "poisons scheduling" of various essential oils by the Australian National Drugs and Poisons Scheduling Committee.

Disparate Views Regarding Toxicity

There is such a diversity of opinion regarding essential oil toxicity because of philosophical differences amongst various people and organizations, a lack of knowledge amongst aromatherapy practitioners, and authors and the fear of public misuse.

Philosophical differences: Utilising Daniel Pénöel's concept of the "aromatic ryptic",[1] we can characterize holistic aromatherapy as fundamentally energetic in nature. Originally developed by Maugerite Maury in France during the 1930's,[2] this approach has become the dominant form of aromatherapy practiced in English-speaking countries. Employing relatively low dosages of essential oils (generally 2.5% or less in massage applications), the majority of noted therapeutic effects appear to be primarily of a secondary "energetic" or "terrain" nature. These affects are similar to acupuncture or homeopathy, and work via the olfactory sphere.

Holistic aromatherapy originated in the domain of beauty therapy. Practitioner training, even up to the present day, has tended to focus on massage and other application methods rather than an in-depth understanding of essential oils from both the chemical/pharmacological viewpoint and their full historical of use in traditional medicine. Maury stated her own preference to avoid the medical applications of essential oils including internal use. Such applications, she felt, were best left to medical practitioners.[3]

Influenced by the work of Maury, the growth of holistic aromatherapy continued, primarily in England. Such practitioners included Marceline Arcier and Daniele Ryman. From the domain of beauty therapy, we can see that a particular dogma has evolved. It is gentle, derived from an energetic perspective, emphasizing low-dose applications and avoiding internal and other high-dose applications. This particular bias has served as the philosophical base on which many widely held beliefs regarding essential oil toxicity are based.

In contrast, the aromatic-medicine approach that developed most strongly amongst French medical practitioners (as well as naturopathic and herbal medicine practitioners) is more of a physical, or rational, approach. This outlook originated from R.M. Gattefosse's work in the 1930's. This "French" approach often utilizes comparatively high doses of essential oils both topically and internally, to accomplish dose-dependent pharmacological effects. This discipline relies on a greater understanding of the chemical structure and pharmacological/toxicological effects of essential oils. This allows practitioners to set safe dosage levels and contra-indications for use. I can therefore suggest that such dosage recommendations represent a more fact-based view of essential oil applications.

Limited knowledge: As I have mentioned above, holistic aromatherapy training has not generally taken into account any in-depth understanding of either the chemis-

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try or known pharmacology of essential oil compounds. As a result, many of the dosage recommendations and contraindications mentioned in aromatherapy literature are based on an incomplete or limited understanding of the issues involved.

There are statements in many publications based on an incomplete understanding of these materials. If an author is not aware of the realities regarding the possible negative effects of an essential oil, any possible negative effect might be noted with the recommendation to avoid use or high-dose application. To err on the side on caution may be considered laudable, however, such exaggerated statements have led to a common perception that the therapeutic use of essential oils can be an extremely risky proposition. This is true even amongst those who are purported to be highly qualified practitioners.

It is my belief that those who would call themselves aromatherapists should be well-acquainted with the actual use and potential toxicities of essential oils, just as we would expect those with either medical training (with pharmaceutical drugs) or medical herbalists (with herbal preparations) to be familiar with common prescriptions.

Public Misuse

The vast majority of aromatherapy books are written for the lay public. In this regard, care is taken to recommend dosages of essential oils and suggest what substances should be avoided to avoid negative reactions or lawsuits. Hence, dosages are kept extremely low, and any essential oil that might be construed as having any possible negative effect, such as disruption of pregnancy, is routinely advised to be best left alone.

If we inspect such books, we also find that these publications, easily accessible to the public, are often used as textbooks in aromatherapy-practitioner training. If we observe further, we also find that many publications offered for practitioners and health professionals make many of the same recommendations. Why is this? I suggest that aromatherapy still needs to go beyond being just a good-feeling fad treatment. As with the standards that have developed in relation to the training and practice of medical herbalism, aromatherapy demands a level of practitioner training that is comprehensive in it's scope and knowledgeable in all the effects of essential oils; both positive and negative.

Toxicity Issues

The most common test of potential human toxicity is the LD50, or median lethal dose. This procedure is routinely applied to laboratory animals (humans do not usually volunteer) in the testing of compounds used in pharmaceuticals, agricultural chemicals, flavors, fragrances and cosmetics, to name a few. In this testing procedure, laboratory animals, usually rats, are given measured doses of compounds until approximately half of the test population

die. The median dosages are then generally given in ratios of test-compound grams to test compound per kilogram of bodyweight. Hence, a LD50 rating of 1.0 means that 50% of the test animals died as a result of a dosage of 1 g per kg of body weight. If we consider ourselves to be large rodents, this would translate to 60 g dose of a particular compound being lethal to an adult weighing 60 kilograms.

We should consider (outside of ethical considerations, because no effective substitute has yet to be found) that such tests generally are based on either acute oral or injected lethal doses. This means that the LD50 dose represents the median toxic dose of the test compound taken all at once, either by ingestion or direct injection.

Chronic (long-term) toxic doses and dermal (high-dose topical applications) have also been studied with laboratory animals. Toxic chronic doses are always less than the corresponding acute dose. Dermal studies have produced conflicting results that do not appear to be entirely analogous to human exposure.[4] In terms of the most common uses of essential oils in aromatherapy, it is the acute LD50 dose that is most relevant in this consideration.

Mistakes in applying LD50 values to aromatherapy applications: Animal LD50 values can be a useful guide to potential essential oil toxicity when we are considering the acute toxicity of essential oils, such as wintergreen (mostly methyl salicylate) or eucalyptus species (those with a high 1,8 cineole content). An essential oil, such as thuja (Thuja occidentalis), with an animal LD50 rating of 0.83, would have an approximately 50-g median lethal dose for an adult weighing 60 kg. This would be a huge dose. Severe toxic effects would still be seen (and have been) at doses as small as 10 g.

It should be restated that the values we are considering here are based on acute oral toxicity, a lethal dose that would be ingested all at one time. There are two areas where mistakes relative to aromatherapy toxicity statements are made.

Dosages: Essential oil dosages, such as those applied in preparations for massage, baths, home deodorizers or inhalations, are generally of a minute fraction of the acute toxic dose. Wintergreen oil, for example, has an acute oral rat LD50 of 1.2. In humans, however, methyl salicylate does appear to be more toxic. Given the numbers of fatalities in years past, with the amount ingested being known in a number of cases, we can estimate a human LD50 of 0.3. For a 60 kg adult, this would translate to the ingestion of about 18 g.[5] If one wanted to apply a 2.5% dilution of wintergreen oil to a sore lower back, 1 ml of this preparation would be used.

One ml x 2.5% = approximately 0.025 g of methyl salicylate. 0.025 g ÷ 18 g (LD50 dose) = 0.00139, or 0.139%. Hence, the applied dose is only 0.139% of the lethal dose, or more than 700 times less.

If we increase the applied amount of the 2.5% formula, we would increase the dosage received. Hence, if we

applied 10 ml of the formula all at once, the dose would now be 0.25 g or 250 mg. Putting this into perspective, even if the methyl salicylate was totally absorbed, this dose would represent the same amount of salicylate compounds found in one tablet of aspirin. Wintergreen and sweet birch are routinely mentioned as essential oils to avoid in aromatherapy applications, even for trained practitioners. Members of the International Federation of Aromatherapists take a vow not to use wintergreen essential oil.[6]

We have a strange contradiction of many methyl salicylate-containing topical products (containing 10-30% methyl salicylate) being readily available to the untrained public with very few negative side-effects reported. Methyl salicylate, even used topically, is contraindicated in people taking the anti-coagulant drug, warfarin.[7]

Even with this relatively toxic compound (as I would suggest that any essential oil with an LD50 of less than 1.0 is), an effective anti-inflammatory preparation can be used with no potential for toxic effects.

Method of application: Not only should we consider the dosage given, but also account for how the essential oil is applied. We can say that the oral ingestion of an essential oil is generally both fully and rapidly absorbed into the portal blood circulation. However, all other types of applications do not represent the same level of absorption and dosage. The following chart (Table 1) details the potential toxicity of each method of application. This accounts for both the amount of absorption as well as the amount of the typical dose given.[8]

Table 1. Potential toxicity of several essential oil application methods

Oral ingestion	+++++
Rectal	++
Vaginal	+
Topical (skin)	+
Inhalations	0

In this light, we understand how the relatively toxic essential oil of pennyroyal can be a safe and effective tool as a mucolytic used in an inhalation. With inhalations, absorption is quite high, but the typical dose is always small. With topical applications, we cannot assume full absorption of applied essential oils. If we do not occlude (or cover) the site of application, as is generally the case with topical aromatherapy applications, the dose is significantly lessened by evaporation.

One US study found that after application, 75% of an applied dose of various fragrance compounds was absorbed through human skin when the application site was

covered. When the skin was left uncovered, the total amount absorbed dropped to four percent.[9]

It is clear that topically applied essential oils will penetrate the epidermis of the skin. However, it is an area that requires further research to understand how a variety of different factors, including the type of essential oil compounds, excipient (carrier) base used, and temperature, affect the amount absorbed through the skin. Available studies suggest a wide range of absorption amounts. *d*–Limonene, the major constituent of most citrus oils, was demonstrated to only have an absorption rate of two percent when applied to human tissue samples.[10]

A two percent dilution of true lavender oil *(Lavandula angustifolia)* applied to the abdomen of a volunteer, showed that approximately 10% of the substance was absorbed into the general blood circulation. This showed a relatively rapid absorption rate that peaked 20 min after application. After 90 min, both linalool and linalyl acetate (the compounds tested for) levels had dropped almost to zero, showing almost complete metabolism.[11]

A study testing percutaneous absorption with rhesus monkeys used three compounds: benzyl alcohol, benzyl acetate and benzyl benzoate (all naturally occurring in ylang ylang essential oil). When applied in a moisturizing lotion base with the skin uncovered, the total absorption rate varied from approximately 20% for benzyl acetate, to 70% for benzyl benzoate.[12] The assumption is that essential oils and like compounds are more easily absorbed through hair follicles than the stratum corneum ("horny layer" of the skin). Hence, it appears that monkey skin, covered in hair follicles, would more efficiently absorb essential oils.

Taking the available research into account, it would be fair and conservative to state the following when figuring the absorbed dose of an essential oil applied to unbroken skin in some form of an excipient (vegetable oil, cream, gel, etc.) and left uncovered. Under such conditions, one can expect no more than 50% of a topically applied dose to be absorbed. In the case of the wintergreen oil example given above, instead of the low amount of 0.025 g being absorbed, the amount can be figured at half that value, or 0.0125 g. This is less than 1/1400 of the toxic oral dose.

This is relevant to the two most common aromatherapy treatments, such as massage and topical OTC preparations (methyl salicylate-containing liniment products). However, in the case of broken skin, where the stratum corneum is compromised or not present (as in wounds, burns and various forms of dermatitis), it would be more prudent to figure a 100% absorption of applied essential oils.[13]

Everything is dose-related: There are a number of essential oils mentioned in aromatherapy books listed as, "never to be used in therapy". These include hyssop, pennyroyal, tansy, thuja, wintergreen and wormwood.[14] Many scientists, however, know that such essential oils can be used safely, if one simply respects the dose given and the method of application used.

Essential Oils and Pregnancy

The use of essential oils during pregnancy is perhaps the most emotive area of aromatherapy. The subject gives rise to a variety of highly conservative statements. These range from recommending that no essential oils be used during pregnancy,[15] to the more common suggestion of using very low doses of only the most non-toxic essential oils. Any "emmenagogic" essential oils, those with any possible effect on the menstrual cycle, should definitely be avoided, according to most literature.

This popular belief appears to be due to the "when in any doubt, don't use it" philosophy, the misuse of toxicity values, and the fear of public misuse and subsequent lawsuits. There also appears to be a general misunderstanding of the hormonal and physiological processes that occur during pregnancy. There are three main areas of concern:

- Some essential oils could damage the developing foetus (known as teratogenicity), causing either resorption of the foetus or birth defects.
- Some essential oils could cause abortions, miscarriages or premature birth.
- Essential oils that effect hormone levels could either disturb fertility or otherwise affect a healthy pregnancy.

Dosage concerns: There are a number of reported cases involving large oral doses of essential oils causing either severe toxic effects or death in unborn children.[16] These cases are almost exclusively due to pregnant women taking large, toxic doses of specific essential oils, notably pennyroyal, rich in the ketone, pulegone, which is metabolized into the highly toxic furan epoxide, menthofuran, and parsley seed, rich in the dimethyl ether, apiol, in an attempt to abort the foetus. Such compounds are very poor abortifacients indeed. Women are frequently severely poisoned, sometimes fatally, and other times without aborting the unborn child.

Studies have been carried out using isolated samples of the human uterus exposed to essential oils often used as abortifacients (juniper, pennyroyal, rue, savin and tansy). The essential oils that were tested did not directly stimulate the uterine muscle (which would cause spasms and possible expulsion of the foetus).[17] Other studies have also shown that such essential oils do not create spontaneous abortion by causing the direct death of the foetus.[18]

Pulegone is only abortifacient in large quantities. By causing acute hepatotoxicity (liver damage), the body is unable to maintain the pregnancy.[19] Pennyroyal, ingested in doses as high as 7.5-10 ml has failed to create an abortion.[20] With apiol, the lowest dose that induced abortion was equivalent to the ingestion of 1.5-6 ml of parsley seed oil daily for eight consecutive days.[21]

As one can see, when many aromatherapy authors equate the use of small fractional doses with huge toxic doses, the

facts are being interpreted wrongly. I have seen some suggested protocols recently concerning the use of vaporizing essential oils in the general environment of a nursing home setting. It is suggested that any essential oil with possible toxic or "emmenagogic" effects not be used if any of the staff is pregnant.[22]

Let us look back at the example of using pennyroyal oil in inhalations. As an example, we will use a 10% concentration of pennyroyal oil with other essential oils such as *Eucalyptus radiata* and sea pine. We will also employ an aerosol generator that disperses approximately 1.0 ml of essential oil per hour. There will be 15 min inhalation sessions three times a day. We will over-compensate and assume a very high degree of essential oil absorption (50%). Under these conditions, we have the following results:

- 15 min x 3 sessions = 45 minutes x 1.0 ml per hour = 0.75ml dispensed.
- 0.75 ml x 50% absorption = 0.375 ml possibly inhaled and absorbed.
- 0.375ml x 10% (pennyroyal content) = 0.0375 ml, or approximately 35 mg of pennyroyal oil.
- The LD50 of pennyroyal oil in humans is 0.4. For a 60 kg adult, this would represent about 24 g of essential oil.
- 35 mg ÷ 24 g = 0.14% of the median lethal dose.
- This is almost 700 times less than the toxic dose.

Of course, this is a tiny dose. If such an essential oil blend were to be vaporized into the general environment of a room, the dose inhaled would be a small fraction of the 35 mg of pennyroyal oil possibly absorbed by a direct inhalation. Many such examples could be given, from the use of 12.5-25mg of thuja oil applied to a wart to kill the papilloma wart virus, to rosemary CT camphor and basil CT methyl chavicol used as a 5.0% dilution for the relief of lower-back pain in the third trimester of pregnancy. In both cases, the applied dose is far below any toxic levels, acute or chronic.

Birth defects: The only essential oil compound that has been shown to have strong teratogenic effects in laboratory animals is sabinyl acetate. The essential oil tested was plectranthus (*Plectranthus fruticosus*, not available commercially), with a sabinyl acetate content of more than 60%.[23] Other sabinyl acetate-containing essential oils are savin (*Juniperus sabina*, 20-53% sabinyl acetate), *Juniperus pfitzeriana* (not available commercially) and Spanish sage (*Salvia lavandulifolia*, generally less than 10% sabinyl acetate, but, at times as high as 24%). Savin oil has also been shown to have abortifacient effects and to be toxic to early embryos in laboratory animals.[23]

Of all the essential oils, savin and Spanish sage should be most often avoided during pregnancy, at any dose. Safrole–rich essential oils (most commonly Brazilian sassafras, *Ocotea pretiosa*,, and Chinese sassafras oil, the safrole-rich fraction of *Cinnamomum camphora)* do not create birth defects per se, but have demonstrated a tendency to produce both kidney and liver tumors in the offspring of mice fed the substance while pregnant.[24]

Whether safrole poses such a risk to humans is still debatable. Safrole is now banned both as a food additive and as a therapeutic agent (in Western countries) because of it's carcinogenic effects in laboratory animals. However, there remains room for debate relative to the applicability of such studies to humans, relative to the large dosages tested and the theoretically non-carcinogenic metabolites produced in humans versus the carcinogenic metabolites produced in laboratory mice.[25,26]

Emmenagogue-like properties: A number of essential oils are stated as having or menstrual regulating or hastening effects in aromatherapy, such as clary sage, rose, jasmine absolute, juniper and sweet fennel, to name a few. It is often suggested that such essential oils not be used during pregnancy because of their reputed hormone-like properties and uterine-stimulant effects. There are two apparent mistakes made in the translation of "emmenagogic" effects to pregnancy.

Uterine stimulation: The actions of some herbs have been suggested as being uterine stimulants, by specifically creating uterine hyperaemia (increased blood flow).[27] Some of these herbs, most notably pennyroyal and parsley seed,

are certainly contraindicated in large oral doses, due to their systemic toxic effects. Uterine contractions are secondary to the toxicosis.

Juniper (*Juniperus communis ssp. communis)* essential oil appears to have been mistakenly identified as such a substance in place of savin (*Juniperus sabina),* which is, in fact, an abortifacient.[28] Although the total water/ethanol extracts of Juniper (*J. communis)* have shown an anti-fertility effect in laboratory rats, this effect does not appear to have any bearing on the essential oil constituents when compared to essential oils such as nutmeg, with similar constituents, even when used at high dosages.[29]

Other herbs with significant essential oil **c**oncentrations, notably angelica root, fennel, garlic, jasmine, true lavender, lovage, sweet marjoram and thyme are wrongly classified by one author,[30] using the "energetics" of traditional Chinese medicine, suggesting they are contraindicated in pregnancy as uterine stimulants. However, it should be noted that such herbs, as commonly used and as reported in contemporary medically oriented phytotherapy texts, do not suggest any contraindications during pregnancy.[31,32] Thyme (*Thymus vulgaris CT thymol, carvacrol)* is one such herb. In reviewing some of the available literature, the real reason that a stigma is placed on the substance is because of the use of pure thymol as a vermifuge internally.[33] At a suggested dose of up to 1.0 g per day, this level of thymol represents a dose of approximately 2.0 g of a high-thymol-containing thyme essential oil. This is a very large internal dose.

The previously mentioned author[30] listed a number of oils as contraindicated during pregnancy. These recommendations appear to have been "lifted" from current aromatherapy texts without a full consideration of their attributes. According to one traditional Chinese medicine practitioner who specializes in gynecological treatments, only the essential oil-bearing herbs of frankincense and myrrh should be omitted during pregnancy (there are other herbs, not available as essential oils). This is specifically due to their capacity to "vitalize the blood, pull blood down and circulate the Qi".[34] In all due fairness, such contraindications are given for the internal use of such herbs in all people. It is suggested that all such "extrapolated" herbs (speaking from a traditional Chinese "energetic" perspective as essential oils are not contraindicated for use in topical applications (at a suggested 2% dilution for general massage use).[35]

Emmenagogic Effects

Essential oils with menstrual-regulating or hormone-like effects include quite non-toxic essential oils such as cedarwood (*Juniperus virginiana*; it is often mistakenly suggested that it has effects similar to *Cedrus atlantica*, which is rich in the sesquiterpene ketone, atlantone), clary sage, jasmine, sweet marjoram (*Oreganum majorana)*, peppermint, rose (*Rosa damascena)* and rosemary (no chemotype

given). Essential oils with estrogen-stimulant activity are also included, such as anise seed, fennel and basil.[36] Such essential oils, amongst others, have been labelled in some aromatherapy books to be entirely avoided during pregnancy.[37] However, I suggest that such recommendations are based on a misguided understanding of processes that occur during pregnancy.

Menstruation versus pregnancy: Menstruation is most specifically controlled via the hypothalamus/hypophysis axis. The anterior pituitary releases gonadotrophic hormones. In the first half of the menstrual cycle, FSH (follicle-stimulating hormone) stimulates the growth of the developing Graafian follicle, which is responsible for the production of estrogen. This estrogen controls the changes in the secondary sex organs, including the proliferation of the endometrium or lining of the uterus.

After the ovum is released, the anterior pituitary releases an increased amount of LH (lutenizing hormone), which stimulates the corpus luteum to develop. The corpus luteum then secretes progesterone (and estrogen) which stimulates further changes in the secondary sex organs and prepares the lining of the uterus for the reception of a fertilized ovum. If the ovum is not fertilized, the corpus luteum shrinks, the production of progesterone and estrogen falls, and menstruation begins.

Herbs such as chaste berry (*Vitex agnus castus*) and black cohosh (*Cimicfuga racemosa*) are known for their menstrual-regulating effects. Both herbs have been shown to work, not by adding sex hormone-like compounds to the body, but by stimulating and/or decreasing the production of FSH and lutenizing hormone by the anterior pituitary. This consequently affects the menstrual cycle.[38]

The only essential oil compound found in research studies to have a mild estrogenic action in laboratory animals is anethole, a major constituent of anise seed, star anise, fennel and *Ravensara anisata* essential oils.[39] Other essential oils that have suggested menstrual-regulating effects, through a long history of traditional use and/or significant results in clinical experience, include clary sage, sage (*Salvia officinalis*), lovage, angelica root, niaouli and cypress.

In all such cases, the effects appear due to a secondary effect via the anterior pituitary, not by the addition of hormone-like compounds. The reported effects of the essential oil of clary sage (*Salvia sclarea)* bear this out. Many anecdotal reports have been given regarding the effects on menstruation exclusively by inhalation of the essential oil.[40]

It is interesting to note that inhalation of such volatile and lipophilic compounds, such as those found in essential oils, may not affect only the central nervous system via the olfactory nerves. Compounds of a larger molecular size have been found to be capable of actually travelling via the

olfactory nerves to reach, in measurable amounts, the limbic regions of the brain. This is as yet unproven, but given the absorption into the brain of both small particles of gold and NGF (nerve growth factor), the absorption, via the olfactory nerve, of essential oil compounds is quite likely.[41]

If we look at what occurs when an ovum is fertilized and embedded in the lining of the uterus, a much different process occurs. When pregnancy occurs, the usual ovarian cycle is suspended. The corpus luteum, instead of shrinking, now grows until it comes to occupy up to 50% of the ovary. The corpus luteum secretes a large amount of progesterone, which serves to maintain the pregnancy in the early stages of development and promotes the development of the placenta. As the placenta develops, the corpus luteum begins to shrink, becoming inactive by the fourth month. The placenta then produces progesterone, supporting the pregnancy until birth.

It is here that contraindications are mistakenly issued for supposedly emmenagogic essential oils. If such oils have an effect on the anterior pituitary, producing FSH (follicle stimulating hormone), there are no graafian follicles to stimulate (which secrete estrogen). The process of pregnancy specifically overrides the menstrual cycle, both physiologically (via the growth of the corpus luteum) and hormonally. Therefore, respecting those with potential toxicity (such as large oral doses of rosemary CT camphor), these emmenagogic essential oils are quite safe to use during pregnancy.

Essential Oils Not to be Used on the Skin

Most aromatherapy books and training courses routinely give a listing of essential oils that should not be used on the skin. The IFA's (International Federation of Aromatherapists) recommended list includes the essential oils of ajowan, cinnamon bark, cassia, clove, oregano and mountain savory (in the "not to be used at all" list).[42] This appears to be based on the philosophical bias that has developed in holistic aromatherapy. Such aromatherapists generally do not employ oils in concentrations exceeding 2.5%. This percentage is recommended for the whole body and, often, the face.

It is a fact that a 50% concentration of red thyme oil would not be suitable for facial treatments. However, we then observe the conundrum whereby trained aromatherapists are forbidden to use such oils while the untrained public can purchase and use products such as "Tiger Balm", which contains a 60% concentration of essential oils, including large amounts of the banned oils of cassia, clove and camphor.

The oils listed above all contain either phenols or aromatic aldehydes with a definite dermocaustic, or skin-irritant quality. In truth, such essential oils can be used safely on the skin, if one respects the dose, sensitive skin areas and avoids the use of such oils on those with sensitive skin (i.e. in cases excema or children under twelve years of age).

Other essential oils, such as costus, elecampane, massoia, oxidized terpenic oils such as *Pinus ssp.*, and citrus oils have significant skin-sensitizing potential and are best avoided for topical use. The "French" approach has long used such dermocaustic oils on the skin, even in high concentrations, as we can see in the work of Jean Valnet and others.[43,44]

The "Phenol Rule"

Daniel Pénöel introduced me to the practice of "aromatic perfusion" some years ago. In this application, I have used up to 20 ml of undiluted essential oils on the skin of many clients, for specific conditions. As part of this work with clients, I have developed and tested what I would call the "henol rule". This "rule" is for the use levels of phenolic oils (mainly red thyme, ajowan, clove bud, oregano and savory) as applied in a whole-body massage (excluding the face). In my practice, I employ a concentration not exceeding 10% for massage. This is generally applied in the treatment of physical conditions, such as muscular complaints, fatigue states, pre- and post- illness symptoms and the like.

Instructions for the "phenol rule": For use in a concentration not exceeding 10% for topical applications, the "phenol rule" recommends:

- The use of 90% of non-irritant essential oils (i.e. true lavender, *Eucalyptus radiata*, tea tree, etc.) to 10% of phenolic essential oils. Hence, the concentration of phenolic oils will not exceed one percent.
- The only exceptions to this are cinnamon bark and cassia (high cinnamic aldehyde). If used, the proportion should not exceed five percent and should be used in conjunction with clove bud (or other high eugenol-containing oils) or citrus oils (with high content of *d*-limonene), which will cancel-out the potential sensitizing effect of cinnamic aldehyde.[45]

I have used this type of application on many clients, with no reported negative skin reactions. Over the past nine years, I have tested the undiluted concentrate of 90% mild oils/10% phenolic oils on over 500 people attending seminars. I can report only four cases of negative reactions to the concentrate. All four cases involved merely transient irritation and mild skin reddening, which resolved in 10-20 min. Neither lasting negative effects nor sensitization have ever been observed.

For application to small, specific body areas, the concentration of phenolic oils can be raised considerably. As in "Tiger Balm" **a**nd similar products, the total essential oil content can be up to 60% (at times, even 100%) with perhaps 30% of the essential oils being phenolic. Irritant effects can be very useful by increasing blood supply to an area, decreasing the production of the inflammatory series-two prostaglandins,[46] and promoting the induction of the antioxidant enzyme, NADPH quinone reductase.[47]

Additionally, local pain and inflammation can be reduced, as in the case of an arthritic joint or menstrual cramps.

Untested Essential Oils

Some authors have suggested essential oils that have not undergone formal scientific testing (generally via the fragrance industry's Research Institute for Fragrance Materials, for testing relative to toxicity, dermal irritation and sensitizing effects on laboratory animals and human volunteers) should not be used on the skin.[48,49] Such statements create contradictions. For example, both Alpine juniper (*Juniperus communis ssp. alpina*) and "Spanish" lavender (*Lavandula stoechas*) essential oils are described in one text as: "Untested Oil. Avoid Use on Sensitive or Damaged Skin."[50] However, both oils are also listed as having beneficial properties for the skin; "Spanish" lavender for wounds and cuts, and Alpine juniper for acne and wounds. Which would the authors have us believe?

Both essential oils have been tested on numerous clients by French practitioners and other therapists, like myself, who have become familiar with many of these unique "untested" oils. A number of such essential oils may never be tested formally, because they have no use in the flavor or fragrance market; they are more likely to be used by aromatherapy practitioners for their therapeutic benefits.

I suggest that such cautionary statements are more than prudent. The great tradition of botanical medicine would never have developed if healers and physicians had not experimented and worked with medicinal plants and without the benefits of many laboratory animals. Based on a history of safe use established by practitioners and an understanding of the effects of individual components (sensitising compounds, such as lactones, and potentially toxic compounds, such as the ketones, pulegone and pinocamphone), I can see no reason to not examine the potential therapeutic qualities of these more unique essential oils.

Essential Oils and Medical Conditions:

There are many oft-repeated statements regarding the use of essential oils in certain medical conditions (it seems that many aromatherapy statements are passed from author to author to author).

Essential oils not to be used with high blood pressure: The essential oils of hyssop, rosemary, sage and thyme are most often listed as having negative effects on high blood pressure.[51,52] I am not certain where these statements originated from, but there is no clinical support to be found anywhere in available literature. No such contraindications appear in herbal texts,[53,54] in scientifically-based phytotherapy texts,[55,56] nor in French aromatherapy texts.[57,58]

Some essential oils have been shown to have hypotensive effects in laboratory animals, including garlic, tagetes, geranium and true lavender.[59] Only one essential oil, clary sage, has been shown to produce a slight increase in both systolic and diastolic blood pressure.[60] However, these effects generally require huge doses. Clary sage required a dose of 1.0 g per kg, or about 70 g for an average adult! Such essential oils will not create negative effects in either low or high blood pressure conditions.

Essential oils not to be used with epileptics: The essential oils of sweet fennel, hyssop, sage and wormwood are often listed as contraindicated in the case of epilepsy.[61] In this case, such contraindications do have a basis in fact. Large doses of monoterpenic ketones, notably pinocamphone, thujone, camphor and pulegone, have been found to create epileptiform seizures in both animals and humans.[62] This, then, would include the more common essential oils of wormwood, mugwort, buchu, hyssop, pennyroyal, sage and thuja.

As a result of this, those with epilepsy (as well as people with high fevers) have a lower tolerance threshold with the CNS (central nervous system) stimulating effects of oils containing large amounts of these ketonic compounds. How sweet fennel entered the picture, I am not sure. Jean Valnet states in his book, *The Practice of Aromatherapy,* "In high doses, fennel causes convulsions (in direct contrast to aniseed). The essence makes animals timid." I assume that the convulsions were observed in animals.

To begin with, no dosages are mentioned in this text (I would assume a large dose was used). Interestingly, both sweet fennel and anise seed oils contain high amounts of trans-anethole (up to 70% and 96%, respectively). If anethole were the responsible agent, similar actions would be seen. I theorize that a bitter fennel (*Foeniculum vulare var. vulgare)* may have been used. The ketone, fenchone, with potential epileptic effects at high doses, is present at up to 18% in the essential oil, whereas sweet fennel (*Foeniculum vulgare var. dulce*) contains generally less than 3%.[63] No other study suggests this potential effect resulting from either sweet or bitter fennel oil. Given the available information, there is no evidence that these substances should be contraindicated for those with epilepsy.

People whose epileptic seizures are under full control by medication do not appear to be any more sensitive to such essential oils than those without epilepsy. Low-dose topical uses of such essential oils should be without incident.[64] Contraindications (even for low-dose topical use) in this case, would be applicable only for those with uncontrolled epilepsy or high fevers.

Essential oils as kidney irritants: Juniper berries (*Juniperus communis ssp. communis*) and their essential oil have long been indicated as a useful diuretic.[65] However, since the late 1800s, juniper essential oil (and other high-terpene hydrocarbon containing essential oils, such as in various *Pinus* species) has been named a kidney irritant that should not be used on a long-term basis nor during acute kidney disease. Such statements are still mentioned in a number of aromatherapy texts.

It appears that the origin of these statements came from the use of large, fatal doses of juniper oil in dogs. Such high doses cause clouding of the urine, which was assumed to be due to kidney damage. It appears, though, that such cloudiness was simply due to the presence of large quantities of juniper oil metabolites. More recent studies using laboratory rats have found no kidney damage, even when high oral doses of juniper oil were given.

The authors hypothesized that the reputation of juniper oil as a kidney irritant may have come from the use of essential oils containing high levels of the monoterpene hydrocarbons, a- and ß-pinene. The juniper oil used in the study was said to have low levels of pinenes.[66] This study highlights the non-irritancy of juniper berry oil. However, the further hypothesis regarding the irritancy of pinenes does appear to be unfounded.

Both juniper branches' and branches/berries' essential oil contain significant amounts of α- and β-pinene, in addition to other terpene hydrocarbons. Juniper berry essential oil contains α-pinene in levels up to 46%, sabinene up to 28%, and myrcene up to 8%, while juniper branch/berry essential oils contain levels of α-pinene ranging from 40-90% and sabinene from 10-40%.[67] Given such similarities in terpene hydrocarbon content, the original hypothesis is not supported.

A number of reports concerning the ingestion of massive amounts (up to 500 ml) of pine essential oil (from *Pinus pinaster* and related species), which generally consists of up to 90% α- and β-pinene, do not provide evidence of resultant kidney dysfunction or damage. Arguably, both gastric lavage and hemoperfusion are generally employed to reduce the quantity of essential oil compounds in both the stomach and circulating blood (a lethal dose of pine oil is approximately 60-120 ml). Nevertheless, large quantities of metabolites, such as bornyl acetate, are still excreted via the kidneys over a number of days.[68]

Of all the essential oil compounds, only apiol (as in parsley seed oil) has been shown to create kidney damage, as observed in post-mortem studies. Obviously, these represented large, (and obviously) fatal doses of the substance. The lowest acute fatal dose on record was 6.3 g, while doses of up to 19 g have been survived.[69] Given the comparatively tiny doses that would be used in aromatherapy treatments, even orally, we can see that such dosages do not pose any threat to the kidneys, even with extended use. Of course, acute (such as glomerulonephritis) or advanced kidney disease (such as requiring dialysis) is where caution must be taken with respect to essential oils and a wide variety of drugs.

Essential oils and other medical conditions: There are both known and potential contraindications for the use of essential oils in certain medical conditions (such as high-menthol containing essential oils in heart disease with cardiac fibrillation) including dosage and combination with drugs (such as using high-methyl salicylate containing oils in conjunction with warfarin anti-coagulant therapy). With the exception of the two above examples, such contraindications are for the oral ingestion of essential oils, not topical applications.[70]

Essential Oil First Aid

As with most medicinal drugs, of both synthetic and natural origin, the compounds present in essential oils have the potential to create serious, even fatal toxic effects, if ingested in overly large quantities. There are numerous cases reported in toxicological literature regarding both serious (non-fatal) and fatal outcomes of essential oil ingestion in both children and adults. These cases are generally due to accidental ingestion by young children, attempts at creating abortions (in past years) and suicide attempts. There are more rare cases of toxic effects due to overly large doses of specific essential oils being self-prescribed by adults or mis-prescribed to children by parents or to clients by ill-informed therapists.

Most essential oil compounds have a non-specific toxic effect, whereby the absorption of these lipophilic compounds into cellular membranes can eventually lead to disruption of membrane permeability. The primary toxic outcome is that of the disruption of ion-channel function in nerve cells, first affecting the heart and central nervous system, leading to cardiac and respiratory depression.[71] To create such effects, however, requires huge dosages in the order of 300 m and beyond.

Certain aromatic compounds, most notably 1,8 cineole (as in many *Eucalyptus* species), camphor (borneone, as an isolated compound or as in *Rosmarinus officinalis CT camphor and Lavandula latifolia)* and methyl salicylate (as a synthetically derived compound or as in *Gaultheria procumbens)* have specific toxic effects at much lower doses. These compounds make up the bulk of both serious and fatal poisonings in children and adults, due not just to their toxicity, but to the common availability of products containing these compounds and their reputed beneficial properties.[72] Given the rapid and almost complete absorption of essential oils ingested orally, this route of administration has the highest potential for toxic effects.

First aid measures for ingestion of significant amounts of particularly toxic essential oils (such as more than 2 ml of high-cineole eucalyptus oil in young children) is straightforward: take the child to the nearest hospital emergency room or at least call or a poison-information center for instructions. The vast majority of accidental essential oil ingestion by children results in few, if any symptoms and resolve safely with no medical intervention.[73]

It is often difficult to determine just how much of an essential oil (or any product) a young child has ingested. If toxic symptoms begin to develop, gastric lavage, hemodialysis and other supportive medical measures may well be necessary. To attempt to either dilute the stomach contents by giving burnt toast (or activated charcoal), milk or other foods or to try to induce vomiting is not recom-

mended. Either approach, if vomiting occurs, has the potential to allow these volatile compounds to enter the lungs, potentially creating aspiration pneumonia.[74]

Aromatic medicine, or the use of essential oils as ingested herbal medicines by trained physicians and complementary therapists, has not been responsible for any severe cases of toxicity. As with any "drug", if an appropriate dose is used (with essential oils, this is often in the range of only 100-300 mg per day), toxicity is not an issue. In the most common practices of aromatherapy, we are talking about topical applications, essential oil preparations used in massage treatments, baths, or low- dose inhalations. Such applications do not create any acute or chronic systemic toxicity. The amounts absorbed into the body and the dosages used are far too low. However, such applications do have the potential to create problems, which include phototoxicity, sensitization and irritant reactions.

Phototoxicity: This side affect is due to the capacity of various furanocoumarin compounds (found in small amounts in some essential oils, most notably in expressed bergamot and lime oils, tagetes, cumin and angelica root, and, to a lesser degree, bitter orange, lemon and grapefruit) to absorb and store ultraviolet wavelengths. This UV radiation is then released in a short, concentrated burst. When essential oils, such as expressed bergamot, are topically applied and the skin exposed to significant amounts of UV radiation in the form of sunlight or tanning beds, a bad "sunburn" is the common result. In more serious cases this can lead to extensive second-degree burns. Another common outcome is that of berloque dermatitis. This effect is recognizable by patches of overly-pigmented skin developments that can last for many years.

There is evidence to support the promotion of skin cancer, caused by repeated exposure to UV light of mouse skin treated with bergamot oil (with bergapten as the responsible agent). However, such results required extensive repeated exposures (5 days per week for 75 weeks), using mice thought to be less capable of repairing DNA damage as compared to humans. Hence, given common uses of such essential oils, carcinogenesis is not an area for serious concern.[75] On a more positive note, evidence suggests that the use of photosensitizing essential oils such as bergamot, along with the use of a sunscreen preparation, provides better protection against UV-induced skin damage than the use of a sunscreen alone.[76]

First aid measures, first and foremost, should be the provision of appropriate label warnings on packages of any photosensitizing essential oil available for public sale. This is presently far too often not the case. In the case of a phototoxic "sunburn" developing, it should be treated as any other burn. If applied soon after exposure, both Vitamin E acetate (up to a 25% concentration) and panthenol (up to a 5% concentration) are excellent at quenching the free radicals produced by UV exposure, significantly reducing erythmea and burning.[77]

In terms of treating a burn, there is a good body of both clinical and anecdotal evidence for the wound-healing effects of various essential oils. This is the case with true lavender (*Lavandula angustifolia*), everlasting (*Helichrysm italicum*), the carbon-dioxide extract of calendula flowers (*Calendula officinalis*), polyunsaturated vegetable oils (such as rose hip, *Rosa rubiginosa)* and a variety of herbal extracts (such as the infused oil of gotu kola, *Centella asiatica)*.[78]

Sensitization: This term refers to the development of an allergic skin reaction to certain aromatic compounds present in some essential oils. Responsible compounds penetrate the epidermis, bind to skin proteins and provoke an immune reaction that leads to the production of histamine and other irritant compounds by basophils and mast cells. A skin rash or eczema is the usual outcome. Subsequent exposure to even tiny amounts of the sensitizing compound can elicit the same response, as well as creating cross-sensitivities to other compounds.[79]

In sensitive individuals, the skin reaction can create extensive skin damage. I have personally witnessed this in the case of a friend applying undiluted tea tree oil to a small foot wound. Both feet developed extensive lesions and required up to six weeks to fully heal. The compounds most often responsible for sensitization include sesquiterpene lactones (such as costuslactone in costus and alantolactone in elecampane), cinnamic aldehyde (as in cinnamon bark, *C. zeylanicum* and *C. cassia)* and oxidized hydrocarbons (such as *d*-limonene in citrus oils, δ-3-carene, and α- and β-pinene in various *Pinus ssp.).* Of potentially sensitizing essential oils, it is cinnamon oil, old citrus and old pine oils that are most commonly available to the public and present the highest risk. The commonly available oils of tea tree, star anise, ylang ylang, and the citral-containing oils of lemongrass and may chang pose a slighter risk.[80]

Sensitization reactions (which are relatively rare) can develop in any healthy individual. However, it is clear that individuals with hypersensitive skin and/or present allergies (including those suffering from eczema, psoriasis and asthma), are more-likely prone to allergic reactions with essential oils. The most prudent approach, especially for those with present allergic conditions, is to do a simple patch test with potentially sensitizing essential oils first. This can be done by preparing a 5-10% dilution of the essential oil in question in vegetable oil and applying a few drops to the inner forearm, covering the area with a Band-Aid. Generally, any sensitization reaction will occur within 24-48 h. The application should be repeated twice to be the most certain.

If a sensitization reaction occurs to any essential oil, obviously it's use should be discontinued immediately. Other risky essential oils or potential cross-sensitizers should only be used with caution. The allergic reaction to an individual compound can disappear over time, but a patch test before use remains highly advised.

The common treatment for an allergic reaction would

be the use of either prescribed or OTC corticosteroid preparations. Alternatively, some practitioners, including myself, have had anecdotal success with the application of essential oils and herbal extracts with anti-inflammatory properties. I have personally found the application of a 5% dilution of the carbon dioxide extracts of German chamomile (*Matricaria recutita)* and calendula (*Calendula officinalis)* in a hypo-allergenic, vegetable oil-based cream to be useful in quenching allergic reactions.

Irritation: These reactions are not allergic in nature, but represent a level of direct skin damage followed by an inflammatory response. Irritation reactions arise quickly and are dependent on the amount of compound applied. Of essential oils that are commonly available to the public, those containing large amounts of phenols, aromatic aldehydes and oxidized hydrocarbons pose the most risk. This includes the commonly available essential oils of cinnamon (bark and leaf), clove (bud and leaf), thyme, oregano, savory, pimento, and old, oxidized citrus and pine oils.

As volatile, lipophilic compounds, any essential oil can be irritating if applied to sensitive mucous membranes or skin, eyes or genitals. The common aromatherapy practice of using essential oils in baths, floating them on the surface of the water, also increases the potential irritancy of essential oils. This is another area where the inclusion of appropriate caution statements, use instructions and realistic expiry dates on packaging would be highly recommended.

First-aid for irritancy reactions includes the removal of the essential oil as quickly as possible from the skin and/or mucous membranes. The common method suggested is to wash the affected skin with soap and water followed by a liberal water rinse. It has been found, with essential oils, however, that the use of water can often increase the skin irritation initially.

I have found a more effective method is to use a vegetable oil. In this method, the oil should be applied to the affected area and removed with an absorbent towel or cloth. The vegetable oil should be repeatedly applied, as much as three or six times. The vegetable oil removes the essential oil from the surface with no irritation.

This method also is excellent for mucous-membrane irritation, such as in irritation of the eyes. A bland vegetable oil can be used as an eye bath instead of water or saline solution. I have had the occasion to use this method myself, accidentally having a large amount of red thyme oil splashed into my eyes. The vegetable oil method was very effective, with any eye irritation abating within 10 min of use.

Summary

In this presentation, I have attempted to cover the fundamental toxicity myths that appear in aromatherapy litera-

ture and training courses. There are other topics that can be considered further, including the appropriate use of essential oils with children and carcinogenic potential. I personally see no problem in authors and trainers suggesting cautious levels of use. However, I would hope to see that such statements be based on the actual known facts of potential toxicity.

Such statements and recommendations would then be given, not as a forbidding absolute, but as personal preference and philosophy. Present aromatherapy recommendations are commonly more than cautious. I sense that they create a mood of fear amongst both practitioners and public. This is a result of a fear of lawsuits. What does one do if a pregnant client wants to sue after having received a massage with true lavender oil and then had a miscarriage?

There is also a level of suppression of the free and discriminative exploration of the therapeutic possibilities of essential oils, which, we must be clear, are not going to be studied by large pharmaceutical corporations any time in the foreseeable future. Essential oil compounds are too simple and cannot be patented. Hence, there is no present incentive for serious research money to be expended on aromatic medicine.

This said, there clearly are certainly negative toxic aspects to the misuse and overdosing of essential oils. For products available to the public, clear instructions and appropriate cautions should be given. In addition, the inclusion of dropper inserts to slow dispensation of liquids into measured drops, should be required for all undiluted essential oils and fragrance oils (perfume oils; mixtures of essential oil isolates, synthetic fragrance compounds, etc.). Experience strongly suggests that these types of restrictive-flow inserts would do more to prevent accidental childhood poisonings than child-resistant closures alone.

For those who would use essential oils as a form of complementary therapy, I suggest that training should take into account all aspects of the safe use of essential oils. The common myths should be excluded and the real potential for negative effects should be fully understood. All parties involved stand to gain greatly from an increased knowledge.

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