

Essential Oils - Viable Wholistic Pharmaceuticals for the Future

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ABSTRACT

Aromatherapy is increasingly popular as approaches to healing with natural substances are favored by the public and make it possible for the lay person to attempt self-therapy. The development of medical aromatherapy and selected works which demonstrate the therapeutic usefulness of essential oils will be outlined. The emergence of a market for essential oils for wholistic aromatherapy will be discussed as well as policies to utilize essential oils as wholistic pharmaceuticals in the primary health care systems of developing nations.

DEVELOPMENT OF AROMATHERAPY

Through the concept of aromatherapy a new scope of usage for essential oils has developed over the last 20 years. To give a precise account of these uses it is first necessary to clarify the meaning of the word aromatherapy briefly, as the concept has become so popular with the public that it has also attracted a fair share of scientific attention. Regrettably in the scientific world the definition of aromatherapy is not at all clear and different authors are advancing vastly different definitions of aromatherapy.

In a situation like this it is most useful not to advance yet another definition but to look at the literature and assess the historic development of the term as well as the practice it covers.

Aromatherapy, as we observe it today, originated in 1937 with the publication of a work of the same name by René-Maurice Gattefossé [1], even though the argument can be made that this practice existed for many centuries, and simply did not have a name. But Gattefossé did in fact create a system of aromatherapy which is based on modern scientific thought and experimentation. He understood aromatherapy as a medical form of therapy with a basis formed by those essential oils whose effects were well tried and researched and the properties of which could be seen as equal to conventional drugs of the time. Aromatherapy as Gattefossé understood it was a classic allopathic therapy based on the concepts of conventional medicine in which an essential oil is first of all used to treat a disease and which is ingredient (complex mixtures as essential oils may be) oriented. Interestingly Gattefossé also saw the effects of essential oils in a broader context. He knew about the psychological and neurological effects of essential oils and so foreshadowed the wholistic take on aromatherapy which has become dominant today.

The next step in the development of aromatherapy came in the form of Dr. Jean Valnet's book on aromatherapy [2], first published in French in 1964, which catalyzed the popular use of essential oils on a larger scale. While addressed to a lay and medical audience at the same time, the way Valnet understood and recommended aromatherapy was basically identical with the understanding of Gattefossé. It took 12 years from the publication of Valnet's book in the French language to its translation into English and German in 1976. At this time Robert Tisserand's book, "The Art of Aromatherapy", was published in England [3]. This work is the first to leave the purely medical approach of aromatherapy behind, combining medical applications with a more esoteric view of

essential oils. But even so, in 1976 aromatherapy is still a medical modality, as even “The Art of Aromatherapy” recommends the internal use of medicinal essential oil blends.

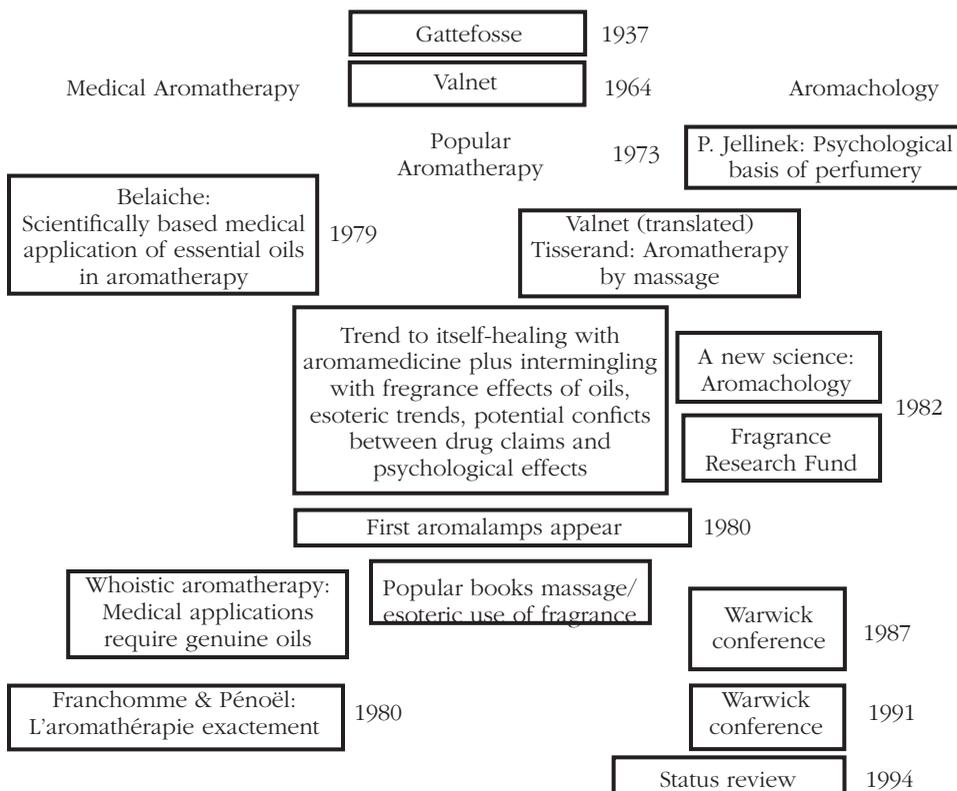
Availability of these two works to a broader public outside the francophonic world can be credited with making aromatherapy a household word. Starting from this point, where aromatherapy was an intriguing, semi-medical modality which allowed the lay person to attempt self-therapy for many common ailments, many other interpretations of aromatherapy have developed. Some of these interpretations are rather esoteric, others began to concentrate on the fragrance aspect and developed into quite different forms of perfume or fragrance therapy [4]. In looking back it is obvious that it was the popularity of aromatherapy, as described above, which initiated the broadening commercial and scientific interests in the effects of fragrance and olfaction which have become so popular. Adding to the growing popularity of the topic of olfaction was the fact that commercial exploitation of the medical application of essential oils in many western societies is restricted or completely prohibited. As a result the fragrance aspect of the aromatherapy phenomenon was the one attracting commercial interest as it stayed clear of potential conflict with existing regulations.

As it were, the development of the aromatherapy phenomenon after 1980 diversified into four basic avenues: Medical and wholistic medical aromatherapy as practiced in France, popular and esoteric aromatherapy as found in publications in all western societies, aromatherapy applied during massage as practiced mainly in Great Britain and the scientific study of fragrance as it is encouraged by the Fragrance Research Fund. A summary of cornerstones of these developments is given in Figure 1.

Medical Aromatherapy

Mainly for infection treatment, was extensively researched by Paul Belaiche [5,6,7]. This work, published in 1979, to date remains unique in combining extensive in-vitro research on the antimicrobial effects of essential oils with the corresponding, successful clinical application of essential oils in a conventional medical fashion.

FIGURE 1: Cornerstone in the development of the different interpretations of aromatherapy



This tradition was continued in 1990 with “L’ aromatherapie exactement” [8] by Pierre Franchomme and Daniel Péroël, the current textbook of medical aromatherapy. It combines modern

scientific thought with a clearly wholistic orientation seeking to understand the effects of essential oils based on the pharmacology of their constituents. The bias of the authors is that, while allowing for variations brought about by the steam distillation process, seasonal variation of essential oil composition and so on, there is a superiority of unaltered essential oils over synthetic, semisynthetic or so-called "nature identical" substances. Factors seen as contributing to this rationale are unique stereochemical or enantiomeric proportions, influence of trace substances and the like. It is for this reason that modern, wholistic aromatherapy requires genuine (unaltered) and authentic (only from one, clearly identified species) essential oils for its therapeutic applications. This has already led to a somewhat split market for essential oils. While established manufacturers and/or brokers sometimes seem unimpressed by the comparatively small size of the market, smaller distillers began producing essential oils for the needs of the aromatherapy market. While quantities absorbed by this market are significantly smaller than those needed by the fragrance and other industries, prices paid are considerably higher. For instance the aromatherapy market has been willing to pay approximately \$ US 200 - 300 per kilo for genuine Rosemary oils which, according to the literature [9], is a more realistic price for a genuine oil than the \$ US 20-40 which are usually asked for in commerce. Nonetheless, the market in developed nations for genuine oils has expanded steadily, especially as treatment of civilization diseases and infections with alternative means like medical aromatherapy is increasingly favored. According to a market study published by Robert Tisserand in 1993, the market value of essential oils sold for the purpose of aromatherapy in the UK was between £6m and £8m but could be as large as £20m if diluted and premixed products were included [10]. This gives a good indication of the market sizes in other European countries, North America and Australia. In 1993 the value of essential oils sold by two aromatherapy market leaders in Germany was approximately DM 15m, not including sales of their competitors.

Popular aromatherapy

An explosion of literature was experienced, concentrating mainly on the English approach to aromatherapy, whereby treatment is administered by an aromatherapist using essential oils in massage [11,12,13,14]. In Germany, the orientation of the published literature often became increasingly non-scientific - some of it even inadequately described by the word esoteric.

Fragrance and olfaction

More isolated efforts to research the involved processes and possible biological impact of different odorants received a large boost in 1982 by the creation of the Fragrance Research Fund by the Fragrance Foundation [15]. The Fund created a new science, identified as 'aromachology'. The object is, in the words of Annette Green, chairwoman of the foundation, to study - in a strictly scientific manner - "the interrelationship of psychology with the latest in fragrance technology", whereby odorants of all origins are given equal consideration. Consequently, two conferences about the psychology and biology of fragrance were held at Warwick University, England and proceedings published [16]. Recently an article by J.S. Jellinek appeared in *Perfumer & Flavorist* [17] reviewing the status of this new science, and also giving valuable guidelines as to the differences between aromatherapy and aromachology.

REEVALUATION OF THE VALIDITY OF ALTERNATIVE THERAPIES

Public sentiment of criticism and environmental concern: Under the growing burden of the cost of conventional health care systems, public scrutiny of such systems has increased. Occurrences of negligence or unethical conduct of drug makers [18,19,20] have at

least disturbed public confidence in such systems and have created increased willingness to look at competing modalities. Adding to that is the well publicized antibiotics crisis [21] which sheds an entirely new light on essential oils as anti-infectious agents.

Environmental concern: As everyone is aware, large segments of the public in the western industrial societies are favoring environmental conservation and moderation by chemical and other polluting industries. Essential oil production satisfies these concerns as it is a sustainable, ecological way of producing pharmaceuticals.

Change in political acceptance: In the United States an office for the evaluation of alternative medicines has been established by the National Institutes of Health [22]. In Canada, under cost pressure, alternative medical methods have received a new look from the regulatory entities. In Germany, phytomedicine has always been able to maintain a viable presence in the market place.

THE DEVELOPMENT OF MEDICAL AROMATHERAPY

As already outlined, the work of Belaiche puts medical aromatherapy on sound footing. In his work, the effectiveness of 42 essential oils against 12 of the most common pathogenic microorganisms was determined through an extensive series of in vitro experiments. An 'Aromatic Index' was introduced which characterized the overall effectiveness of any of the investigated essential oils against all the pathogens studied. Besides principles of direct effectiveness against pathogens, equal consideration was given to improving the 'terrain', improving the abilities of the organism to ward off disease by creating equilibrium in the central and the autonomic nervous systems as well as in the endocrine system. Clinical regimens were developed and carried out for corresponding infectious diseases including acute and chronic bronchitis, rhinitis, sinusitis, otitis, cystitis, skin infections, hepatitis, herpes simplex and zoster, childhood diseases, tuberculosis and malaria.

In a broad effort to classify the antimicrobial effectiveness of essential oils, Belaiche introduced the aromatic index, a measure of the median effectiveness of oils against different microorganisms averaged over a large number of clinical cases.

Table 1: Microorganisms included in the derivation of the aromatic index

1) Escherichia coli, 2) Proteus morgani, Proteus mirabilis, Proteus rettgeri, 3) Alcalescens dispar, Cornyebacterium xerose, Neisseria flava, Klebsiella var. oxytoca, 4) Streptococcus faecalis (gram +), 5) Staphylococcus alba, 6) Staphylococcus aureus, 7) Streptococcus B, 8) Pneumococcus and 9) Candida albicans

For every case of infection for the duration of the clinical evaluation, a culture was obtained. Then, the ability of the essential oil to inhibit the growth of the respective microorganism was assessed on a scale from 0 to 3 for each case. On this scale 0 stands for no inhibition, 1 for mild inhibition, 2 for medium and 3 for strong to complete inhibition of growth of the microorganism. The inhibition numbers for each case were then added up and divided by the maximum possible value for inhibition, which is the number of cases (or the respective cultures) multiplied by 3. That is, in the study of 36 cases of infection with pathogenic E. Coli bacillus, Origanum was found to be:

very effective in 29 cases (respective inhibition number 3),

$$29 \times 3 = 87$$

effective in 2 cases,

$$2 \times 2 = 4$$

and ineffective in 5 cases.

$$5 \times 0 = 0$$

The total of all inhibition numbers is 91. The maximum possible number (36 x 3) is 108.

Therefore, the index for the efficiency of Origanum against E. coli is $87 : 108 = 0.84$.

The overall median aromatic index is then derived by adding up all the indices for one oil and dividing by the number of different indices that were added. The essential oils with the highest median efficiency against all the test organisms are shown in Table 2.

Table 2: Essential oils with the highest aromatic index values:

| Essential Oil | Aromatic Index |
|--|----------------|
| Myrtle (<i>Myrtus communis</i>) | 0.250 |
| Lavender (<i>Lavandula vera</i>) | 0.296 |
| Fennel (<i>Foeniculum vulgare</i>) | 0.312 |
| Pine (<i>Pinus sylvestris</i>) | 0.317 |
| Rosemary (<i>Rosmarinus officinalis</i>) | 0.317 |
| Cajeput (<i>Melaleuca cajuputi</i>) | 0.333 |
| Clove (<i>Eugenia caryophyllus</i>) | 0.517 |
| Cinnamon (<i>Cinnamomum ceylanicum</i>) | 0.687 |
| Thyme (<i>Thymus vulgaris</i>) | 0.711 |
| Oregano (<i>Origanum</i>) | 0.873 |

The effectiveness of many of these treatments has been corroborated by independent pharmacological studies of other authors.

Respiratory Diseases

Bacteria: In their investigation of the antimicrobial effects of essential oil constituents, Wagner and Sprinkmeyer [23] concluded that a combination of terpenes as is present in the traditional formula of 'Melissengeist' was more effective against microorganisms implicated in respiratory infections than broad-spectrum antibiotics. The authors distinguished between microorganisms which are usually centrally involved in such diseases (group 1) and others which are less commonly but potentially peripherally involved (group 2).

The effective mixture of terpenes and phenylpropanoids consisted mainly of caryophyllen, citral, eugenol, eugenolacetate, limonene, linalool, alpha terpineol, cinnamic aldehyde, citronellal, citronellol and geraniol.

Inhibited microorganisms: Group 1) Pneumococci, Klebsiella pneumoniae, Staphylo-coccus aureus, Neisseria catarrhalis, Streptococcus haemolyticus, Proteus vulgaris, Haemophilus influenzae, Haemophilus pertussis. Group 2) Candida albicans, Coli-Enterobacter group, various Corynebacteria, Listeria.

Viruses: In carefully executed in vitro experiments Deininger and Lembke [24] demonstrated the ability of essential oils and a variety of common essential oil constituents to protect various human cell cultures from Herpes and Adeno viruses without being toxic to the cell cultures.

Table 3: Non toxic range of inhibition of Adeno virus (mg. inhibitor substance per ml cell lawn) in different cultures.

Cell Culture:

| Inhibitor substance | Girardi | Flow 12000 | Intestine | Vero Kidney |
|---------------------|---------------|---------------|---------------|-----------------|
| Piper nigrum | 0.1 - 0.00001 | 1.0 - 0.1 | 0.01 - 0.0001 | 0.1 - 0.00001 |
| Cassia (flores) | 0.1 - 0.00001 | 0.01 - 0.001 | 0.1 - 0.001 | 0.0001 - 0.0001 |
| Cardamom | 1.0 - 0.01 | 0.01 - 0.001 | 0.1 - 0.001 | 0.01 - 0.0001 |
| Eugenol | 0.01 - 0.001 | 0.01 - 0.001 | 0.01 - 0.001 | 0.1 - 0.001 |
| Cinnamic aldehyde | 0.1 - 0.0001 | 0.01 - 0.0001 | 0.1 - 0.01 | 0.01 - 0.0001 |
| Anethol | 1.0 - 0.001 | 0.1 - 0.001 | 0.1 - 0.001 | 0.1 - 0.001 |
| Linalol | 0.01 - 0.001 | 0.01 - 0.001 | 0.01 - 0.001 | 0.01 - 0.0001 |
| Linalyl acetate | 0.01 - 0.01 | 0.01 - 0.001 | 0.01 - 0.0001 | 0.01 - 0.0001 |
| (+) Carvone | 0.1 - 0.01 | 0.1 - 0.01 | 0.01 - 0.001 | 0.01 - 0.0001 |
| cis/trans Citral | 0.01 - 0.001 | 0.01 - 0.001 | 0.01 - 0.001 | 0.1 - 0.001 |
| Citronellol | 1.0 - 0.01 | 0.1 - 0.01 | 0.1 - 0.001 | 0.01 - 0.0001 |

Diarrheal Disease

Effectiveness of essential oils, especially those with high proportions of phenolic constituents and cinnamic aldehyde against bacterial microorganisms, has been documented extensively. According to Belaiche treatment of associated infections with aromatherapy is clinically successful especially when supported by phytotherapy, absorbents such as green clay and remineralization with appropriate cations.

Herpes simplex and Herpes zoster

Some of the most impressive results consistently achieved with essential oils are in the treatments of Herpes simplex and Shingles (Herpes zoster). Such treatments have been described by Belaiche

and by Franchomme and Péroël in their respective works. Looking at the variety of compounds, including linalol, linalyl acetate, citral and cinnamic aldehyde, to name only a few found by Deininger and Lembke as effective against Herpes simplex, it is not surprising that such favorable results are obtained with many different essential oils of different compositions.

Systemic Candida

Often implicated in connection with cystitis, but also with other diseases, Systemic Candida is treated very successfully with essential oils of *Thymus vulgaris*, *Melaleuca alternifolia*, *Pelargonium x asperum* and especially those with high ester contents like *Salvia sclarea*. Treatments of Candida with essential oils have been described often in the non-scientific publications [25] and represent one of the most successfully practiced areas of self-therapy within aromatherapy.

WHOLISTIC INTERPRETATION AROMATHERAPY - A THERAPY LINKING THE IMMUNE SYSTEM WITH EMOTIONAL AND PHYSICAL WELL-BEING

An explanation for the surprising effectiveness of these treatments, which often exceeds what might be expected from pharmacological tests alone, can be found in a wholistic interpretation of the spectrum of actions of essential oils. Terpenoids and phenylpropanoids display more complex effects than merely being effective against certain pathogens. They also interact with the immune system, the emotional status, as mediated through neuropeptides and receptor molecules, and with the central and autonomic nervous systems [26].

Interaction between essential oils and immune parameters

Franchomme and Péroël describe the ability of essential oils to normalize pathologically depressed or elevated levels of gamma globulins. Essential oils of *Thymus vulgaris thymol type*, *Thymus vulgaris linalol type*, *Satureja montana* and *Lavandula spica* bolster diminished gamma globulin levels (associated e.g. with chronic bronchitis) while borneol, in the oil of *Thymus satureioides*, reduces elevated levels associated, among other conditions, with chronic enteritis [27].

Autonomic nervous system

Terpenes and phenylpropanoids have been demonstrated to be clinically effective in improving the equilibrium of the autonomic nervous system [28]. Very good therapeutic results were obtained with corresponding symptoms such as nervousness, anxiety, depression, tension, headaches, insomnia and lack of appetite [29,30].

Feedback on immunocompetence and civilization diseases

Current research in the field of neurotransmitters and receptors strongly suggests a direct link between emotional well-being and immunocompetence (Receptors for neurotransmitters are also found on the surface of phagocytes and lymphocytes) [31]. At the same time it is suggested that essential oils or their constituents display their antiviral effects through the blocking of receptor sites, thus preventing healthy cells from becoming infected.

A new area of application is opening up in the search for effective treatments of civilization diseases such as neurodermatitis and asthma. Especially in the area of asthma, properly conducted interventions with essential oils can be very helpful. While the immediate relief offered by synthetic pharmaceuticals clearly cannot

be duplicated by aromatherapy treatments, essential oils have proven effective in reducing the disposition to undergo attacks and to reduce dependency on conventional pharmaceuticals [32,33].

TRENDS IN DEVELOPING NATIONS WITH RESPECT TO EXPORT OF ESSENTIAL OILS AS WELL AS LOCAL USE FOR PRIMARY HEALTH CARE

Based on this new view of the ability of essential oils to be useful, wholistic pharmaceuticals, novel approaches to support primary health care in developing nations have been adopted [34].

Value addition to medicinal & spice plants in developing nations

The German organization, PROTRADE, is a part of the Gesellschaft für Technische Zusammenarbeit GmbH in Eschborn (GTZ). It is the unit responsible for consulting in export marketing, trade and fair trade promotion. Their activities are designed to aid developing countries by improving their ability to cultivate medicinal plants and benefit, by value addition, through the additional processing step of essential oil production by local industries [35]. These measures are taken to benefit local economies in two ways: 1) Improving trade through export of essential oils made from cultivated plants rather than by exporting wild-harvested, raw materials to foreign processors, and 2) Providing essential oils for local markets for primary health care. For an appreciation of the potential of essential oil based health care in developing nations it is useful to take a look at the diseases causing, in absolute numbers, the most deaths globally:

Deadliest Diseases:

(Figure 2). Figures of the World Health Organization show that, by western standards, rather manageable diseases are the most efficient killers on a global scale, or for that matter in developing countries.

Figure 2: The deadliest diseases

| Infectious disease | Cause | Annual deaths |
|------------------------------|--------------------|---------------|
| Acute respiratory infections | Bacterial, Viral | 4,300,000 |
| Diarrheal diseases | Bacterial or Viral | 3,200,000 |
| Tuberculosis | Bacterial | 3,000,000 |
| Hepatitis B | Viral | 1-2,000,000 |
| Malaria | Protozoan | 1,000,000 |
| Measles | Viral | 880,000 |
| Neonatal tetanus | Bacterial | 600,000 |
| AIDS | Viral | 550,000 |
| Pertussis (whooping cough) | Bacterial | 360,000 |

Source: World Health Organization; Harvard School of Public Health, 1990 figures.

Traditional healing systems:

Between 50-90% of the population in developing countries depend on traditional healing systems, rather than “modern” western medicine, to treat these diseases [36]. It is the aim of development policies of organizations like PROTRADE to strengthen primary health care provided by traditional healing systems. This is achieved through scientific and technological support provided to the traditional healing systems and, consequently, through increased availability of locally produced essential oils.

Infectious diseases in these countries are often a result of poor hygienic conditions and low nutritional standards and are of a nature often easily controlled with medical aromatherapy. Essential oils can be utilized in multiple ways; by improving hygiene, as a preventative measure and as intervention when disease needs to be treated.

As a result, demand for genuine essential oils for primary health care in developing nations may ultimately eclipse that of the more industrialized countries.

Genuine oils from developing countries:

As a result of PROTRADE activities, genuine oils from countries like Nepal, Madagascar, Tanzania and El Salvador are beginning to gain a share in the aromatherapy markets of industrialized nations, mainly France, Germany and the US. Essential oils from these countries, having found their way into aromatherapy commerce, include: *Nardostachys jatamansi*, Palmarosa, Basil, Vetiver, Niaouli, Cinnamon and Cardamom. It appears that essential oil manufacturers in developing nations are comfortable in satisfying the requirements for genuine oils by customers interested in medical aromatherapy.

REFERENCES

1. René-Maurice Gattefossé, *Gattefossé's Aromatherapy*. C.W. Daniel Company Limited, Saffron Walden, UK (1993).
2. Jean Valnet, *The Practice of Aromatherapy*, Destiny Books, New York (1980).
3. Robert B. Tisserand, *Aromatherapie, Heilung durch Duftstoffe*. Hermann Bauer Verlag, Freiburg (1980).
4. Rudolf Hänsel, *Therapeutische Anwendung ätherischer Öle*. In: *Ätherische Öle Anspruch und Wirklichkeit*, Ed. Reinhold Carle p. 222. Wissenschaftliche Verlagsgesellschaft mbH, Stuttgart (1993)
5. Paul Belaiche, *Traite de phytothérapie et d'aromathérapie*, Tome 1 *L'aromatogramme*. Maloine S.A. Paris (1979).
6. Paul Belaiche, *Traite de phytothérapie et d'aromathérapie*, Tome 2 *Les mala-dies infectieuses*. Maloine S.A. Paris (1979).
7. Paul Belaiche, *Traite de phytothérapie et d'aromathérapie*, Tome 3 *Gynecologie* par M. Girault. Maloine S.A. Paris (1979).
8. Pierre Franchomme; Daniel Pénoël, *L'aromathérapie exactement*. Limoges (1990).
9. G. Lerch, *Impressionen einer Rosmarinreise*. SÖFW, 116 (10), 418-419 (1990).
10. Robert Tisserand, *Aromatherapy Today*. In: *Aroma '93 - Conference Pro-ceedings*, Aromatherapy Publications Hove, UK (1993).

11. Valerie Ann Worwood, *The Complete Book of Essential Oils and Aromatherapy*. New World Library, San Rafael (1991).
12. Rodolphe Balz, *Ätherische Öle Heilkräftige Essenzen*. Windpferd Verlagsgesellschaft, Aitrang, Germany (1994).
13. Marcel Lavabre, *Aromatherapy Workbook*. Healing Arts Press, Rochester (1990).
14. Martin Henglein, *Die heilende Kraft der Wohlgerüche und Essenzen*. Schönbergers Verlag, München (1985).
15. Annette Green, *Fragrance Education and the Psychology of Smell*. In: *Perfumery*. Eds. van Toller and Dodd, p.227, Chapman and Hall, London (1988).
16. Steve Van Toller; George H. Dodd, *Perfumery*. Chapman and Hall, London (1988).
17. J.S. Jellinek, *Aroma-Chology: A Status Review*. *Perfumer & Flavorist*, 19, (5), 25 - 49, (1994).
18. Kurt Langbein; Hans-Peter Martin; Hans Weiss; Roland Werner, *Gesunde Geschäfte*. Kiepenheuer & Witsch, Köln (1981).
19. Thomas J. Moore, *Deadly Medicine*. Simon & Schuster, New York (1995)
20. Michael Castleman, *Why? - Breast cancer*. *Mother Jones*, 34-42, San Francisco, May/June (1994).
21. Michael Schmidt; Lendon Smith; Keith Sehnert, *Beyond Antibiotics*. North Atlantic Books, Berkeley (1993)

22. Tracey Minkin, Scintillating Scents. *Cooking Light*, 9 (3) 26-29, *Cooking Light*, Birmingham, AL (1995).
23. H. Wagner; L. Sprinkmeyer, Über die pharmakologische Wirkung von Melissengeist. *Deutsche Apotheker Zeitung*, 113, 1159-1166 (1973).
24. A. Lembke; R. Deininger, Wirkung von Terpenen auf mikroskopische Pilze, Bakterien und Viren. In: *Phytotherapie. Grundlagen - Klinik - Praxis*. Eds. H.D. Reuter; R. Deininger; V. Schulz, pp. 90-104, Hippokrates, Stuttgart (1987).
25. William G. Crook, *The Yeast Connection*. Random House, New York.
26. Rolf Deininger, Zentrale Wirkung der Terpene. *Erfahrungsheilkunde*, 24 (10) 261-264 (1975).
27. Ref. [8], pp. 155-156.
28. K. Büchner; H. Hellings; M. Huber; E. Peukert; L. Späth; R. Deininger, Doppelblindstudie zum Nachweis der therapeutischen Wirkung von Melissengeist bei psychovegetativen Syndromen. *Medizinische Klinik*. 69, 1032-1036 (1974).
29. O. Hammer, Wirkungsnachweis zur therapeutischen Anwendung von Terpenen. *Folia phytotherapeutica*, 6, 4 (1974).
30. K.H. Lingen, Über die therapeutische Wirksamkeit von Melissengeist bei psychovegetativen Syndromen. *Die Heilkunst*, 87 (2), 1-3 (1974).

31. Candace Pert, The Chemical Communicators. In: Healing and The Mind, Bill Moyers, pp. 177 - 193, Doubleday, New York (1993).
32. Monika Haas; Kurt Schnaubelt, Breathing Space. The International Journal of Aromatherapy, 4 (4), 13 - 15 (1992).
33. Kurt Schnaubelt, Aromatherapie. vgs, Köln (1995).
34. Klaus Dürbeck; A. Wildner, Handelsförderung von Extrakten aus Arznei und Gewürzpflanzen sowie Phytopharmaka. Entwicklung und ländlicher Raum, 4, 18 - 19, (1991).
35. K.A. Dürbeck; A. Wildner, Trade Promotion of Medicinal and Aromatic Plant Products - a PROTRADE offer to developing countries producers. In: First World Congress On Medicinal And Aromatic Plants For Human Welfare. Eds. Ch. Franz; R. Seitz; N. Verlet, pp. 55 - 64, Maastricht, Netherlands (1992).
36. Klaus Dürbeck, Scope of Value addition for Medicinal Plant Products through local industries in Asia, Africa and Latin America. Cultivation and improve-ment of medicinal and aromatic Plants. International Meeting Trento, June 2-3, (1994).