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# Aromachology and its Application in the Textile Field

## Abstract

*A research attempt at obtaining aromatherapeutic textiles which we carried out is presented, together with the broad background of research into aromachology investigation. We developed aromatherapeutic textiles using the fragrance with  $\beta$ -cyclodextrin inclusion compounds. The sedative effects for emotion and the pharmaceutical effects of essential oils are presented in detail, on the basis of the achievements of aromachology and aromatherapy. Research shows that the effects of fragrance on humans are based on a great deal of medical experience.  $\beta$ -cyclodextrin was chosen for the aromatherapeutic textile as host molecule, because it exhibits qualities which are beneficial for the human body.  $\beta$ -cyclodextrins molecules are capable of forming inclusion compounds with fragrances that fit into the cone-shaped hydrophobic cavity. As a result, the release-fragrance rates are greatly decreased. The fragrance inclusion compounds are fixed onto cotton with a low temperature binder by the conventional pad-thermo-fixed method. The fragrance-release rates are related to the nature of the fragrance oils themselves. The results of sensorial evaluations show that the perfume of fabric is sensed for over 30 days. An aromatherapeutic textile could be achieved by means of the fragrance with  $\beta$ -cyclodextrin inclusion compounds in this way.*

**Key words:** *Aroma-chology, aromatherapy textile, pharmacological effects, physiological effects, perfume microcapsule.*

## Introduction

Pure fragrance compounds and essential oils have been used traditionally in folk medicine for a long time. It is discussed nowadays because of its viable holistic pharmaceutical effects and the trend back to natural drugs and therapies in medicine. The term aromatherapy was coined in the late 1920s by the French cosmetic chemist R.M. Gattefosse, who noticed the excellent antiseptic properties and skin permeability of essential oils [1]. Dr G. Bauchbauer, a modern aromatherapist of renown, has proposed the following definition of the word aromatherapy: therapeutic uses of fragrances which at least mere volatilize to cure and to mitigate or cure diseases, infection and indisposition by means of inhalation alone [2].

The term aromachology [1] was coined in 1982 to denote the science that is dedicated to the study of the interrelationship between psychology and fragrance technology to elicit a variety of specific feelings and emotions – such as relaxation, exhilaration, sensuality, happiness and well-being – through odours via the stimulation of olfactory pathways in the brain, especially the limbic system [3]. The difference between aromatherapy and aromachology is difficult to describe definitively and succinctly. Notwithstanding the evident relationships between them, they have different research methods and research directions. Regrettably, in the scientific world, the definition of aromatherapy has not as yet been made clear.

The developments of the aromatherapy phenomenon after 1980 diversified along four basic avenues [4]: Medical and holistic 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 encouraged by the Fragrance Research Fund.

In the meantime, beauty companies have begun to incorporate aromachology or aromatherapy into their product development. The US retail sales of all home fragrance products, which are divided into environmental fragrances and fresheners, climbed nearly 11 percent to \$1.96 billion in 1999, over 1998 sales of \$1.77 billion, according to information from Kalorama, a New York City-based market research firm. The investigation of US retail sales of home fragrance shows that sales increased 9.7 percent, from \$1.35 billion in 1995 to \$1.96 billion in 1999, and are projected to increase by 7.9 percent to \$2.87 billion in 2004 [5]. The most strongly performing sector is environmental fragrances, which comprise incenses, aromatherapy products, and specialty products such as pomanders and scented drawer liners. The investigation shows that sales of environmental fragrances are driven by the 'cocooning' trend to create pleasant home environments, as well as by the products' functional use as odour neutralisers, insect repellents or smoke reducers [6].

The new development in textile is selling for active wear, leisurewear and intimate apparel. The approach will combine innovative fibre and textile technologies designed to appeal beyond their basic physiological and functional benefits [7]. The Research Institute on Social Change (RISC) has identified the key trends shaping consumer attitudes and motivations. The investigation showed that we have a need for balance, pleasure and enjoyment, excitement and renewal, and personalisation, and its trends reflected that. [8]

Balance translates as distressing and restorative in a range of innovative fabrics that are pampering and energising. Pleasure and enjoyment, on the one hand, is about daring to be different, but also about forgetting stress. Excitement and active wear is a form of communication. Finally, personalisation is about self-expression and individuality [9].

The scents of lavender, rose, citrus or vanilla were encapsulated into fabrics, which proved a good way to meet important psychological and emotional needs, as well as those of a purely physical and sensorial nature [10]. These kinds of fabrics are so-called aromatherapeutic textiles.

The aim of this study is to discuss the current state of investigation into the application of aromachology in textiles, as well as the development of aromatherapeutic textiles which we have carried out. These textiles manufactured with the use

of  $\beta$ -cyclodextrins and the encapsulation technique can elicit a variety of specific feelings and emotions, such as relaxation, exhilaration, and happiness, and can also kill harmful bacteria, thanks to the achievements of aromachology and aromatherapy.

## Research works of aromachology

During the past ten years, a considerable amount of research has been conducted in the United States, Europe and Japan to measure not only the effects of fragrance upon feeling, moods and emotions, but also upon several areas of response [11]: electrical activity in the brain, physiological parameters such as the heart rate and skin conductance, cognitive functions and voluntary & involuntary behaviour.

Belaiche determined the effectiveness of 42 essential oils against the 12 most common pathogenic micro-organisms through an extensive series of experiments [12]. An 'Aromatic Index' was introduced, which characterised the overall effectiveness of the investigated essential oils against all the pathogens studied. He found that the essential oils with a higher Aromatic Index could effectively prevent *Escherichia coli*, *Proteus morgani*, *Candida albicans*, *Staphylococcus aureus* etc.

Torii et al. studied the contingent negative variation (CNV) and the physiological effects of odours in humans [13]. They found that the presentation of a jasmine odour caused a significant increase in the CNV measured at the frontal and left central sides of the cortex, while a lavender odour caused a significant decrease. Taking a nap and drinking a cup of coffee changed the CNV in the same direction; an increase in the CNV was interpreted as signalling stimulation and a decrease as signalling relaxation.

Bauchbauer's team studied the effects of single aroma chemicals and essential oils inhaled by mice [14]. They investigated 44 chemicals and essentials with ascribed sedative effects on humans. The studies showed that lavender oil, its main constituents, linalool and linalyl acetate, as well as neroli oil, benzaldehyde and East Indian sandalwood oil, decreased the motility of untreated mice by 40-78%, compared with the control group.

Torii investigated the effects of odours upon the skin's potential level (SPL) [15]. SPLs are related to mental perspiration, and corresponded well with the arousal level of the subject: -40 mV upon awakening, -60 mV at the time of excitement, and near zero mV during sleep. Measurements of the SPL via the contingent negative variation (CNV) clearly showed the variation of the SPL in parallel with the level of activity of the sympathetic nervous system. Torii reported that the scent of camomile oil produced a sedative effect, while the scent of jasmine oil was stimulating.

Nasel performed Xe-computer-tomographic studies on eight healthy volunteers aged between 20 and 30 years old, and one tested anosmatic woman, with a view to observing the cerebral blood flow upon inhalation of 1,8-cineole [16]. In all cases, the CBF of these subjects increased when they inhaled this compound. The anosmatic woman reacted in exactly the same way. It showed that an increased CBF could not be the result of a reflectoric event. In addition, the concentration of 1,8-cineole in the blood was determined. Resorption was very fast, as could be shown during the period from 4 to 20 minutes by an almost

**Table 1.** The pharmaceutical effects of essential oils [3,4].

Effects	Essential Oil
Sedation	Mint, Onion, Lemon, Metasequoia
Coalescence	Pine, Clove, lavender, Onion, Thyme
Diuresis	Pine, lavender Onion. Thyme, Fennel, Lemon, Metasequoia
Facilitating Menses	Pine, lavender. Mint, Rosemary, Thyme, Basil, Chamomile, Cinnamon, Lemon
Dismissing sputum	Onion, Citrus, Thyme, Chamomile
Allaying a fever	Ginger, Fennel, Chamomile, Lemon
Hypnogenesis	Lavender, Oregano, Basil, Chamomile
Curing Hypertension	Lavender. Fennel, Lemon, Ylangylang
Be good for stomach	Pine, Ginger, Clove, Mint, Onion, Citrus, Rosemary, Thyme, Fennel, Basil, Cinnamon
Diaphoresis	Pine, lavender, Rosemary, Thyme, Chamomile, Metasequoia
Expelling wind	Ginger, Clove, Onion, Citrus, Rosemary, Fennel, Lemon
Losing weigh	Onion, Cinnamon, Lemon
Relieving pain	Vanilla, lavender. Mint, Onion, Citrus, Rosemary, Chamomile, Cinnamon, Lemon
Detoxification	Lavender
Curing diabetes	Vanilla, Onion, Chamomile, Lemon
Stopping diarrhea	Vanilla, Ginger, Clove, lavender. Mint, Onion, Oregano, Rosemary, Thyme, Chamomile, Cinnamon, Lemon
Curing flu	Pine, lavender, Mint, Onion, Citrus, Rosemary, Thyme, Chamomile, Cinnamon, Metasequoia
Curing rheumatism	Lavender, Onion, Citrus, Rosemary, Thyme, Metasequoia
Urging sexual passion	Pine, Ginger, Clove, Mint, Onion, Rosemary, Thyme, Fennel, Relieving spasm. Cinnamon
Promoting appetite	Clove, lavender, Mint, Onion, Citrus, Rosemary, Fennel Basil, Chamomile, Cinnamon, Lemon, Metasequoia
Relieving cough	Rosemary

**Table 2.** The sedative effects/or emotion of essential oils [5].

Emotion	Essential Oils with the Sedative Effects
Anxiety	Benzoin, Lemon, Chamomile. Rose, Cardamom, Clove, Jasmine
Lament	Rose
Stimulation	Camphor, Balm oil
Anger	Chamomile, Balm oil. Rose, Ylangylang
Wretchedness	Basil, Cypress, Mint, Patchouli
Allergy	Chamomile, Jasmine, Balm oil
Distrustfulness	Lavender
Tension	Camphor, Cypress, Vanilla. Jasmine. Balm oil. Lavender, Sandalwood
Melancholy	Basil, Lemon, Chamomile, Vanilla, Jasmine, Lavender, Mint, Rose
Hysteria	Chamomile, Balm oil, Lavender, Jasmine
Mania	Basil, Jasmine, Pine
Irritability	Chamomile, Camphor, Cypress, Lavender
Desolation	Jasmine, Pine, Patchouli, Rosemary

linear increase of the 1,8-cineole concentration up to a maximum value of about 275 ng/ml serum. When the inhalation was stopped, the concentration of this chemical in venous blood dropped immediately. It showed that this essential oil was very safe for the human body.

Many methods have been applied in aromatherapy research in order to verify the so-called healing effects of aroma chemicals and essential oils. It is very difficult to separate the psychological from the pharmacological. In fact, more research work is needed.

### ■ Effects of aromatherapy

Lavender is the most used and most versatile of all the essential oils. It is a very useful oil, especially when symptoms are due to a nervous problem [17]. The effects of lemon, camomile, rose, cardamom, clove, and jasmine fragrance oils on human have been confirmed by many research works. The sedative effects for the pharmaceutical and emotional effects of essential oils are listed in Tables 1 and 2 respectively [18-22].

### ■ Microcapsules and aromatherapy textiles

The fragrance compound and the essential oil are volatile substances. The most difficult task in preparing the aromatherapy textile is how to prolong its lifetime of odours. Micro-encapsulation is an effective technique to solve this [23, 24]. Microcapsules are minute containers that are normally spherical if they enclose a liquid or gas, and roughly of the shape of the enclosed particle if they contain a solid. It can be considered as a special form of packaging, in that particulate matter can be individually coated for protection against environment and release the volatile substance from the enclosed capsule as required. This property has enabled microcapsules to serve many useful functions and find applications in different fields of technology [25]. For example, the storage life of a volatile compound can be increased markedly by micro-encapsulating [26].

The key to aromatherapeutic textile is how to make microcapsules of fragrance compounds and essential oils without omitting any ingredient in order to ensure its pharmaceutical effects. In addition, using a low-temperature polymer binder to attach a perfumed microcapsule to the

surface of the textile is also an important part of preparing an aromatherapeutic textile. At the same time, durability in laundering and a soft handle should be carefully considered [27].

Although there are many effective approaches to micro-encapsulation for decreasing fragrance-release, cyclodextrins are the best regarding safety to the human body, because  $\beta$ -cyclodextrin has no skin irritation, no skin sensitisation and no mutagenic effect [28].

Cyclodextrins are non-reducing cyclically linked oligosaccharides produced by certain micro-organisms of cultivated starch, which are capable of forming inclusion compounds with molecules that fit into their cone-shaped hydrophobic cavity [29]. As a result of the inclusion, the physico-chemical properties of the compounds are changed, e. g. the vapour pressure of volatile substance is reduced, and stabilities against light or air are enhanced. On the other hand, the harmful and/or unpleasant odour in the surrounding may be eliminated [30]. Furthermore, cyclodextrins clamped on cellulose do not affect the cellulose's properties, and cyclodextrins keep their ability to form inclusion complexes with other suitable molecules [31]. Thus, cyclodextrins are the first choice in preparing aromatherapy textiles.

The detailed analysis described above allowed us to select the following procedure. The fragrance with  $\beta$ -cyclodextrin inclusions were formed by mixture solution containing alcohol and distilled water (1:3). The solution was emulsified with a high-speed mixer at a speed

of about 10,000 rpm for 5 minutes. The emulsified system was transferred into a flask. The fragrance alcohol solution was added into the emulsified solutions over 30 minutes, and stirred at a temperature of 40 °C for 2 hours. Then the fragrance inclusions were fixed onto cotton with a low-temperature binder by the conventional pad-thermofixed method at 80 °C for 3 minutes.

The uses of aromatherapy textile are diverse. Interior textiles such as sheets, quilt-covers, curtains, carpets and bed-gowns are suitable for the attachment of lavender, camomile, citrus or cinnamon microcapsules, which are good for hypnogenesis and eliminating fatigue. Patients suffering high blood pressure feel sedation when they use a pillow made of fabric treated with lavender, basil, lemon or fennel microcapsules. The tired office clerk wearing clothing with a scent of lemon, rose, or jasmine oil may find his work efficiency improved. Meanwhile, it is convenient for dermatosis sufferers to be cured with the aid of underwear containing killing germ fabric. Perfumed toys make it easier for children to get closer to nature. Generally speaking, varied perfume fabrics create good opportunities for customers to make the 'cocooning' environment they prefer to live in.

### ■ Fragrance release property

There were several different sections to the cyclodextrin's molecular encapsulation compared with other widely-used encapsulation processes. The enclosed substance was totally or partially included in the cyclodextrin cavity. This system was reversible and was not sealed com-

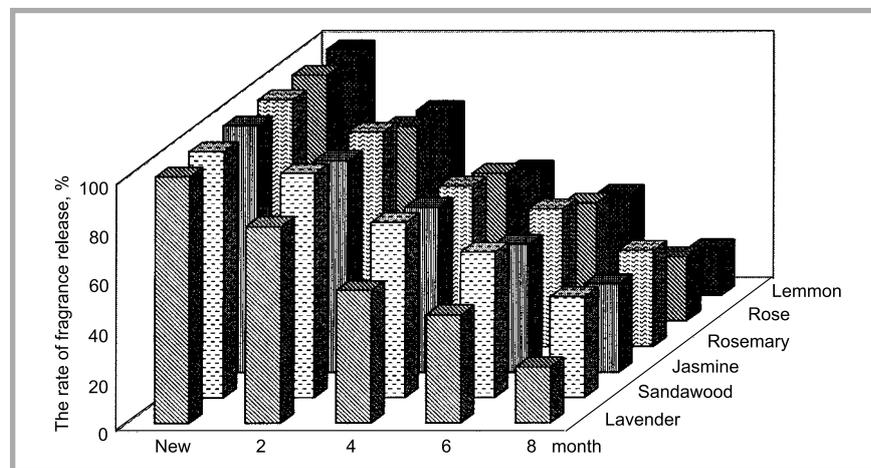


Figure 1. The rate of fragrance-release from microcapsules.

**Table 3.** Sensorial evaluation of scent intensity.

Fragrance substance	Scent intensity					
	5 days	10 days	15 days	20 days	25 days	30 days
Rosemary	+++++	+++++	++++	+++	+++	++
Lavender	+++++	++++	+++	++	++	+
Jasmine	+++++	+++++	++++	+++	++	++
Lemon	+++++	++++	+++	++	+	+
Sandalwood	+++++	+++++	++++	+++	+++	++

+++++ express very strong, ++++ express strong, +++ express common, ++ express weak, + express very weak.

pletely. The forms of the microcapsule were able to notably decrease the rate of fragrance-release.

The fabric treated with the inclusion compound was extracted by alcohol for 12 hours. The fragrance concentration on the fabric was measured on a UV-3000 reflectance spectrophotometer. The excitation wavelength was 276 nm.

The controlled-release properties are given in Figure 1. The different rates of fragrance release of various perfume microcapsules were related to the nature of the fragrance oils themselves. The higher the detection threshold of the fragrance compounds, the lower the rate of fragrance release of the inclusion compound.

A sensorial evaluation of results was also performed by a group of 10 well-trained subjects, in insulated booths where the fabrics were kept on an open desk at room temperature, and smelled every five days in order to sense the scents. The test panel evaluation results were listed in Table 3.

As the 'second skin' of the human body, all types of textile are excellent media for transferring fragrance compounds, and are essential to people according to their preference for them. As was already mentioned above, now we may summarise that aromatherapeutic textiles based on lavender, lemon, chamomile, rose, cardamom, clove, or jasmine has sedative effect, which fits for bed gown, underwear, sheets, curtains, carpets etc. Basil, Chamomile, and lavender can be served for restraining bacterium textiles. We may increase work efficiency after inhaling jasmine, Lavender and Mint scent deposited on aromatherapeutic garment. Generally speaking, restraining bacterium product is usually be used on underwear, whereas outerwear such as a sweater is good to fulfil other pharmaceutical effects of essential oils.

## Summary

Aromatherapy is increasingly popular as one of many approaches to healing with natural substances which are favoured by the public, and make it possible for the individual to attempt self-therapy at home. As close friends of humans, textiles can make aromatherapy easy wherever they are needed. Micro-encapsulation can effectively control the release rate of the fragrance compounds and essential oils as required, which ensures the storage life of volatile substances. We may choose various products such as fibres, fabrics, non-fabrics and garments to enjoy the pharmaceutical and emotional effects of aromatherapeutic textiles. We believe that aromatherapy and aromatherapeutic textiles are the first choice for people who want to keep healthy in their daily life, and these textiles will become a fashion in the near future.

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