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A Critical Review of Aroma Therapeutic Applications for Textiles

Dr. A. J. West
Dr. K. E. Annett-Hitchcock

Department of Textiles and Apparel, Technology and Management
College of Textiles
North Carolina State University
Raleigh, NC 27695-8301, USA

ABSTRACT

The aim of this study is to review and assess the development of aroma therapeutic applications in textiles. Recent academic research shows that aroma-enhanced textiles are being developed in the areas of sustainability, environmental consciousness, health and well-being, and enhanced brand awareness. Some essential oils, which can be used to infuse textiles with aromas, are also known to contain antimicrobial properties that can be useful for medical textile applications. What are the conclusions that can be reached and the drawbacks facing a more widespread integration?

Keywords: Aroma, aromatherapy, infused textiles, essential oil, scent

Introduction

In our daily lives, we come into contact with textiles that have been infused with multiple sensory stimulants that are acquired or proactively embedded. Textiles are the holders and diffusers of the perfumes or colognes we apply on our bodies. Nearly all fabrics give off some sort of scent intentionally or unintentionally after the manufacturing process, or in the natural odor of the raw material. Not all of these are pleasant, in fact, sometimes the opposite is true and some fabric finishing can contain a scent that is not attractive or a chemical that is hazardous. The scent can also be consumer generated, such as the use of fabric softeners or scented sheets used in tumble dryers. These scents give off messages to our brain that our clothes are now fresh and ready to be worn, having been infused with an artificial chemical that we associate with clean clothes. Researchers have pinpointed fragrances that "fit" products (such as lemon scent for a household cleaning solution), which have improved product evaluations by customers (Fitzgerald & Jantrania, 1992). In many instances, identified smells are remembered because of their connection to particular people and places and with nostalgic feelings. According to (Waskul, Vannini, and Wilson (2009), "Memory, sensory perception, and nostalgia do not exist prior to an experience, but flow from sensations of that experience. These memories are not

passive records but acts that shape a sense of bodily self and ground that sense of self into experienced and re-livable sensations. For these reasons a sensory product can evoke that nostalgic idealizing activity of the past." (p.12)

According to the National Institutes of Health, plant-derived medicines have been a cornerstone of most folk and traditional medical practices for centuries, and many important modern drugs have deep roots in these traditional medicines (NIH, 2011). The essential oils derived from plants are composed of natural aromatic molecules endowed with many physiological as well as pharmacological properties, for which applications are found in almost every field of medicine, not only curatively, but also preventatively (Steflitsch & Steflitsch, 2008). Substances derived from plants remain the basis for a large proportion of the commercial medications used today for treatment of heart disease, high blood pressure, pain, asthma and other conditions (Chandrasekaran, Ramachandran, & Vigneswaran, 2012).

Essential oils and plant extracts are assumed to be ecologically sound and there is generally an absence of unwanted side-effects arising from the use of essential oils (Verdet, 1989). However, as with any substance it is important to consider certain factors such as the dosage levels, purity of the product. The Research Institute on Social Change has identified the key trends shaping consumer attitudes and motivations. Their investigation shows that consumers have a need for balance, pleasure and enjoyment, excitement and renewal, and personalization.

The Center for Spirituality and Healing at the University of Minnesota describes wellbeing as a state of balance or alignment in body mind and spirit (CSH.UMN, 2014). Infused aromatic textiles can be used to bring life balance, using restorative and de-stressing properties that pamper and energize (Bartolomeo, 1999). Fragrance finishing of products enhances the value of the product by adding beneficial factors, which can affect mood (Gilbert & Firestein, 2002). For example, Hirsch and Gay (1991) showed that consumers were prone to purchase athletic shoes when the room was infused with scent as opposed to when the room had no scent. In addition, the increasing significance of branding for product distinction makes research on the role of scented products important. *Gobe (2001)* suggests that retailers will increase market share and maintain leadership in their market niche if they connect on an emotional level to the end consumer in terms of lifestyle identification. *Whether we like it or not, scent permeates our lives on many levels, in practically every product we use.*

*The current 'green' trend is moving away from the use of chemical and non-*sustainable *products, in favor of those considered not harmful to nature. In addition to health and wellness benefits, the replacement of artificial scent with essential oils that are naturally derived can be considered environmentally responsible. With a growing market share in herbal products, research shows that the use of essential oils for fragrance are underrepresented in everyday product applications as compared to chemical fragrances. Recent research has been taking place to impregnate essential oils into textiles and garments for holistic medicinal purposes. This paper will* critically review the recent research methods of aroma therapeutic applications for textiles.

Complementary and Alternative Medicine (CAM)

Aromatherapy is one of the fastest growing branches of complementary and alternative medicine (CAM). The National Center for Complementary and Alternative Medicine (NCCAM) is the federal government's lead agency for scientific research in this area. They are one of the 27 institutes and centers that make up the National Institutes of

Health (NIH) within the U.S. Department of Health and Human Services. "The goal of NCCAM is to develop effective, practical, and personalized strategies for promoting health and well-being; advanced research in mind and body interventions, practices and disciplines, and to develop and disseminate objective evidence-based information on CAM interventions (NCCAM, 2013)."

The use of CAM is sustained by consumer perceptions of effectiveness due in part to the benefits and risks of many of these traditional remedies that have been poorly documented. The World Health Organization (WHO) estimates that 4 billion people (80% of the world's population) presently use herbal medicine as a common element in aryurvedic, homeopathic, naturopathic, and traditional medicine. WHO notes that pharmaceutical medicines are derived from 199 plants, of which approximately 74% are used in modern pharmaceuticals in ways that relate directly to their traditional uses as plant medicines by native cultures (WHO, 2007).

Definitions

Phytotherapy is the use of the whole, or part, of a plant for medicinal purposes. Its aim is to preserve the complexity of substances from a given plant with the least amount of processing. A sector of this is *aromatherapy*, which involves deriving essential oils from the plant, which are then used to promote physical and psychological well-being. Aromatherapy can be used in combination with massage and other therapeutic techniques as part of a holistic treatment approach (Schnaubelt, 1999). *Aromatology* differs from aromatherapy in that it does not use massage, since massage is not always appropriate or needed, especially where bruising or burning of the skin or broken bones have taken place.

Essential oils are traditionally derived from plant material, mainly from mechanical expression of blossoms, leaves, roots, and seeds. Today's essential oils are more commonly extracted by distillation, often by using steam; other processes include solvent extraction. These individual oils should be from a botanical source and only whole, unadulterated oils should be used (Price & Price, 1999).

Wang and Chen (2005a) suggest the term *aromachology* 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. Odors intrinsic to each plant stimulate olfactory pathways in the brain, especially the limbic system (Jellinek, 1994). People equate essential oils as pleasant, partly because they are drawn from nature and partly because of the reference to a pleasant aromachological past experience.

The whole essential oil has to be considered in all its complexity, which comprises the mixture of possibly hundreds of different types of molecules, their molecular energy and their overall synergy. There is no simple direct relationship between any one of the chemical constituents and the therapeutic or hazardous effect (Jellinek, 1994). Table 1 shows the most popular essential oils and the effects induced.

Table 1. Major Essential oils and effects on body systems

Essential oil	Effect
Basil	Uplifting, refreshing, clarifying, aids concentration
Bergamot	Refreshing, uplifting
Chamomile	Refreshing, relaxing, calming, soothing, balancing
Cedarwood	Sedating, calming, soothing, strengthening
Clary sage	Warming, relaxing, uplifting, calming, causes euphoria
Cypress	Relaxing, refreshing, provides astringent qualities
Eucalyptus	Head clearing, provides antiseptic and decongestant properties, invigorating
Fennel	Provides relief from gas and indigestion
Frankincense	Relaxing, rejuvenating, eases breathing, dispels fears
Geranium	Refreshing, relaxing, balancing, harmonizing
Hyssop	Provides decongestant properties
Jasmine	Relaxing, soothing, builds confidence
Juniper	Refreshing, stimulating, relaxing, promotes diuresis
Lavender	Refreshing, relaxing, provides therapeutic qualities, calming, soothing
Lemon	Refreshing, stimulating, uplifting, motivating
Lemongrass	Toning, refreshing, fortifying
Marjoram	Warming, fortifying, sedating
Melissa	Uplifting, refreshing
Myrrh	Toning, strengthening, rejuvenating, provides expectorant properties
Neroli	Relaxing, dispels fears
Orange	Refreshing, relaxing
Patchouli	Relaxing, enhancing to sensuality
Peppermint	Cooling, refreshing, head clearing
Petitgrain	Refreshing, relaxing
Pine	Refreshing, provides antiseptic properties, invigorating, stimulating
Rose	Relaxing, soothing, enhances sensuality, builds confidence
Rosemary	Invigorating, refreshing, stimulating, clarifying
Sandalwood	Relaxing, warming, builds confidence, grounding
Tea tree	Acts as antiseptic, strengthens immune system
Thyme	Acts as antiseptic, refreshing, strengthens immune system
Ylang-ylang	Relaxing, soothing, enhances sensuality

From Thomas, D. (2002). Aromatherapy: mythical, magical, or medicinal? *Holistic Nursing Practice*, 16(5), 8-16.

In modern times the word 'aromatherapy' was first used in 1937 by the French cosmetic scientist Rene-Maurice Gattefossé, whose research revealed that the volatile extracts distilled from certain aromatic plants had a profound effect on the skin. Gattefosse's own research was confined to the cosmetic uses of essential oils, but he soon realized that many of the oils also had powerful antiseptic and painkilling properties. Gattefossé also discovered that essential oils applied to the skin could be absorbed into the bloodstream where they interact with the body's chemistry. It was not until 1977 that aromatherapy was put in the public eye when British aromatherapist, author and researcher Robert Tisserand authored the book "The Art of Aromatherapy" (Tisserand, 1978).

An oil essence can impart medicinal effects separate from the aroma; but more often, they are intertwined (Buchbauer & Jirovetz, 1994). Pleasant aromas and familiar smells associated with good memories can help re-establish feelings of happiness. "Because the smell reaction bypasses our intellect, going directly to the hypothalamus, odors have an immediate emotional impact quite different from most thoughts, sights and sounds" (Jellinek, 1994, p.58). Davies, Kooijman, and Ward (2003) suggest we take for granted the link between smells, emotions, thoughts, and feelings. We typically associate a smell with a pleasant or unpleasant feeling, rarely ever a neutral one (Shauer, 1998). This does not preclude or negate the notion that many other sensory inputs can stimulate equally pleasant thoughts or feelings. Perception of the experience is what matters most, not the reality of the experience (Thomas, 2002).

Transference of Essential Oils using Textiles

Fragrance finishing of textiles is one such immaculate magnanimous entry into any textile culture (Choudhury, 2006).

Every culture in the history of humankind has embedded scent into textiles. Egyptians are regarded as the true founders of aromatherapy, even though, according to many archaeologists, they had no knowledge of the modern method of distillation used today. Most of their healing oils were prepared by placing aromatic plant material in vegetable oil or an animal-fat base and leaving the mixture to infuse in the sun for several weeks. In Medieval Europe**,** herbal and aromatic substances were used against airborne infections, such as plagues. The burning of herbs in public places to purify the atmosphere and the wearing of pomanders were common to diffuse the noxious odors. There was a close relationship between the role of perfumery and aromatic herbal medicines as perfumers were also called upon to provide protection for their clientele against prevalent diseases (Stevensen, 1998). In the early 1600's fine linen ruffs were laundered in lavender water, ironed, piped, and stiffened with perfumed and sometimes tinted starch. In storage, they were sprinkled with powdered orris root and wrapped in linen covers. In the 1700's and 1880's perfumed handkerchiefs were very popular with the gentry to mask smells from the streets. In 1911 Paul Poiret sprayed his entire collection with his signature scent "Parfums de Rosin" thus becoming the first couturier to link branded fashion to a fragrance. Since the late 1980s, modern technology has enabled microcapsules of perfume in nylon stockings and athletic socks, and permanent, perfumed nano finishings on cotton children's wear. The Korean textile industry is a leader in stress-reducing fragrant finishings for businessmen's suits and ties, and for treating bed linens to release minute amounts of pine forest scent, shown to encourage relaxation (Johansen, 2008). Odor-modulation textiles can be classified into those that suppress or enhance odor perception in either a broad or narrow range (Gilbert & Firestein, 2002).

When essential oils are infused into textiles it is with the intention that these oils migrate to the body either by inhalation or

transdermal application. Researchers are looking for different methods of both infusing the oils into textiles and then later releasing them systematically so they can interact with the body. Transdermal drug delivery is a form of medicinal administration wherein active ingredients are delivered across the skin for systemic distribution, such as transdermal patches. Many chemical compounds extracted from natural sources show potential as skin penetration enhancing agents. Fox, Gerber, Du Plessis, and Hamman (2011) explained that essential oils showed a high affinity for impregnating the skin and have fewer side effects than some transdermal patches. An item of clothing or a product such as a pillowcase allows the essential oils to be placed directly against the skin allowing for a similar transdermal delivery to take place.

Traditional Pad Method

Today many new developments in textiles are for active wear, leisurewear and intimate apparel. These approaches combine innovative fiber and textile technologies designed to appeal beyond their basic physiological and functional benefits (Wang & Chen, 2005a). These garments tend to be made of fabrics with significant stretch and recovery rates, which are worn close to the body as a 'second skin'. Many textiles are excellent media for transferring fragrance compounds, and the relatively lower incidence of adverse effects of herbal products as compared to modern synthetic pharmaceuticals, coupled with their reduced cost, can be exploited as an attractive ecofriendly alternative to synthetic antimicrobial for textile applications (Joshi, Wazed, & Purwar, 2009). *In* recent years attempts have been made to finish textiles with herbal antimicrobial compounds (Ramachandran, Rajendrakumar, & Rajendran, 2004). *Some herbs have natural intrinsic dye capabilities embedded in their roots, leafs, or flowers in addition to the desired aromatherapy properties. The combination of both aroma and natural dye color method is a very holistic approach and was used successfully by Chandrasekaran et al., (2012). In order to finish a fabric with an essential oil, fragrance inclusion compounds are fixed onto the fabric with a pad dry cure method, and the fabric is infused with the herbal solution by the use of squeezing rollers with a low temperature binder and then washed to remove unfixed compounds.*

Chandrasekaran et al. (2012) studied the effect of medicinal herb extract treated garments on selected diseases. The research team developed and tested herb extract pad treated cotton garments as a method of medicinal drug delivery to cure selected diseases. Sixteen medicinal herb extracts were selected and tested for curative effects of seven different diseases. Tests were completed using American Association of Textile Chemists and Colorists (AATCC) standards for antimicrobial activity. They used three different antimicrobial testing methods: AATCC 100; Hohenstein's modified challenge test; JIS L 1902 and wash durability test AATCC 124. The presumptive screenings of fabrics were carried out using Agar diffusion method and further confirmed by calculating the percentage reduction of bacteria using the Shake flask test. The fabrics were tested for their antimicrobial and antibacterial properties. Clinical trials confirmed the correlation between the curative performance and the antibacterial activity. Using the Agar diffusion test SN 195920 a qualitative method to determine antibacterial effect. They concluded that herb extract infused garments can be used as an alternative method of drug delivery to minimize the side effects produced by oral intake. Clinical trial results as well as doctors' evaluation in all cases showed the curative performances were significant. In the case of Staphylococcus aureus testing of antimicrobial effectiveness, it was found that bacterial reduction of curative fabrics ranged from 82-98% and 68-82% for Escherichia coli (both being a representation of gram positive bacteria). It was determined that the effects of the treated garments lasted 10-15

washes using non-ionic detergents. These garments could be used as supportive therapy for treating certain diseases.

Microencapsulation

Another method of infusing fabrics with essential oils is through micro-encapsulation. Microcapsules are minute containers that are normally spherical if they enclose a liquid or gas, and roughly the shape of the enclosed particle if they contain a solid. They generally are applied as a final finish to the fabric by padding or spraying, because of their minute size 3-8 microns they become interlaced into the fabric. They can be considered a special form of packaging, in a particulate matter that can be individually coated for protection against the environment and release the volatile substance from the enclosed capsule as required. Micro-encapsulation can somewhat effectively control the release rate of the fragrance compounds and essential oils as required also (Wang & Chen, 2005a). This method has enabled microcapsules to serve many useful functions and find applications in different fields of technology. For example: the storage life of a volatile compound can be increased markedly by micro-encapsulation (Aggarwal, 1998).

Through micro-encapsulation, fragrances and essential oils are able to remain on a garment for a larger part of its lifetime. Micro-encapsulation has been called the 'holy grail' for most textile applications, as it is easy to apply, does not affect existing textile properties, and has a shelf-life on a garment that allows careful fabric-care processes to take place. Currently, although some capsules can survive 25-30 wash cycles, conventional ironing and other heat input processes such as tumble-drying can cause a dramatic reduction in the desired effect (Nelson, 2002).

Realizing that medical textiles are one of the fastest growing markets for technical textiles, herbal antimicrobial finishes offer a more natural approach than chemical fragrances. Ganesan, Tamil Selvi, and Ramachandran (2012) applied a curative finish made from other herbal extracts such as aloe vera, bitter gourd, cumminum, *cyminum* and ginger, to cotton fabric by micro-encapsulation. Studies revealed the presence and alignment of microcapsules of the fabric. It was found that this method exhibits the potential for antimicrobial activity against S. aureus and E. coli in measurable terms as well as curative effect of skin diseases to some extent. When analyzed it was found that the microencapsulated herbal extracts did retain a very good resistance to microbes. The garments also showed improved results in curing skin diseases such as scabies, inflammatory skin disease, seasonal skin disease, urticarial and eczema.

Alternatives in Microencapsulation

Wang and Chen, (2005a) and (2005b) in their tests of sensorial evaluation of results using human subjects found that the addition of essential oils had added benefits post medical and sensorial evaluation. Aroma therapeutic textiles formed of lavender, lemon, chamomile, rose, cardamom, clove, or jasmine were found to have a sedative effect, and are well suited for bed gowns, underwear, sheets, curtains, carpets, etc.

Aroma therapeutic textiles have been developed using fragrance with β-cyclodextrin inclusion compounds. These compounds are ring like structures that form a dimensional fit between β-cyclodextrin and the guest molecule. The guest substance with the help of the β-cyclodextrin transfers the aroma successfully to the cotton fabric and poses no skin irritation, skin sensibility, or mutagenic or teratogenic effects. β-cyclodextrin was used with the essential oils to produce a compound, which was then applied onto cotton material. β -cyclodextrin molecules are capable of forming inclusion compounds with fragrances within a capsule. As a result, the release-fragrance rates are greatly decreased. Evaluations

revealed that the perfume of the fabric remained detectable for over 30 days. Apparel textiles can make the use of aromatherapy easy to apply where needed due to close proximity to the body. Micro-encapsulation effectively controls the release rate of essential oils, which ensures the storage life of volatile substances. Aromatherapic textiles containing effective, long-lasting fragrances can significantly contribute to the textile industry and have potential for fashion.

Liu, Tovia, Balasubramian, Pierce Jr, and Dugan (2008) and Liu, Tovia, and Pierce (2009) found that fragrance in the herbal oils had more than a therapeutic effect and could involve sales and marketing. Aroma could be used for branding, improving product formulation, and enhancing the customer's perception and experience at the retail level. In their trials they used a filament infusing method before fabric construction to add scent into polymers as an alternative micro-encapsulation. Products (scarves) were knitted from a scented yarn produced using sheath-core bi-component fibers with polypropylene (PP) as the core and polylactic acid (PLA) as the sheath. In order to control scent release, scarves were knitted with different scents, colors, and fragrance concentrations. A consumer survey of the scented scarves received high evaluations. The psychophysical assessment determined that color along with the scent was a significant factor in enhancing consumers' appeal. They concluded scent-infused technology has great potential in the textile field. The lavender-scented scarves had significantly longer fragrance durability than citrus ones over repeated washing and drying cycles. The psychological analysis showed positive ratings among consumers testing scented textiles and demonstrated the potential market of such textile products. The textile's color corresponding with the scent positively influenced consumers' judgment of product satisfaction.

There have been numerous studies indicating that scents have a measurable effect on people's behavior. Chattopadhyay and Shweta (2013) found their study's goal was to synthesize fragranced dyes and apply them to cotton fabric for antibacterial, aromatherapy and other properties. The treated samples underwent testing, which included wash cycles and exposure to sunlight in order to study the fragrance retention of the fabric. Due to the volatile nature of the scented extracts, the fragrance intensity decreased daily and with every wash irrespective of the quantity or type applied. The study also revealed that the fragrance withstood more than 30 days on the fabric in all cases. They concluded the micro-encapsulation method used in this study to be successful in attaching an essential oil scent to cotton fabric via modified dyes. Although fragrance intensity decreases with time and washing, fragrance enhanced textiles enhance the value of the product, thus generating a new avenue of textile application.

Mixed Methods

It is important to recognize that some plant materials are natural antimicrobial agents that can be non-toxic, non-allergenic, relatively easy to access, easy to process and inexpensive, and do not cause some of the problems of microbial resistance that chemical antimicrobial agents do. When researching the health and hygiene of fabrics as some of the primary requirements for healthy living, Thilgavathi, Krishna Bala, and Kannaian (2007) found, that there is a need for antibacterial finishes on textiles to protect humans from pathogens and prevent cross infections. However, some synthetic based finishes are not compatible when they come in contact with the skin and there are many plant product alternatives that have antimicrobial properties.

They considered that consumer preferences were becoming affected by a holistic, sustainable awareness and that there would be higher demands placed on antibacterial finishes to become environmentally friendly. They studied an antimicrobial finish made

from herbal extracts of neem and Mexican daisy, which was applied to cotton fabric using two methods; direct pad application and micro-encapsulation, to compare the antimicrobial effect and durability. The micro-encapsulation method was successful in its application onto fabric and was found to exhibit the potential for antimicrobial activity against Staphylococcus aureus (S. aureus) and Escherichia coli (E. coli) in measurable terms compared to the pad method. Durability tests comparing microencapsulated and directly applied herbal extracts showed that microencapsulated samples retained their activity for more than 15 washes. The pad method lost all its activity by 15 washes.

Ramya and Maheshwari (2013) applied clove extract to eco-friendly bamboo/cotton fabrics using both direct application and micro-encapsulation to evaluate both methodologies. Due to clove extract's worldwide availability there is opportunity for commercialization of such textiles. It is eco-friendly and therefore more socially and environmentally acceptable. Antimicrobial efficacy and wash durability were assessed. Both methods showed good antimicrobial property, additionally the micro-encapsulation method showed good antifungal property. The direct application method lasted through 10 washes, where the micro-encapsulation's results lasted through 30 wash cycles. Clove extract was found to have significant inhibition properties against S. aureus and E. coli bacteria. Wash durability results for the directly applied method were poor, but considered useful for single use applications where a garment is not washed or reused.

Table 2. Performance of curative garments in clinical trails

Curative garment	Disease control	Curative performance
Aloe T-shirt	Allergic dermatitis	Significant
Neem-Portia T-shirt	Psoriasis	Significant
Holy basil T-shirt	Asthma	Significant
Turmo-Neem T-shirt	Liver disorders	Significant
Euca – Head Band	Headache	Significant
Balloon – Joint pain band	Joint pain	Significant
Sandal – Handkerchief	Sinus trouble/cold	Significant

Chandrasekaran, K., Ramachandran, T., and Vigneswaran, C. (2012). Effect of medicinal herb extracts treated garments on selected diseases. *Indian Journal of Traditional Knowledge, 11(3), 493-498.*

Conclusions

Mixed methods have been applied in aro-matherapy research in order to verify the so-called healing effects of aromatic chemicals and essential oils in textiles, but more research is needed. Although many of the herbal extracts have shown consistent antimicrobial properties after application on textile fabrics, their wash durability is poor (Liu et al., 2009). From an application perspective, as garments are subjected to washing, the wash durability of finishes is a major issue. Therefore, the consumer knows the item only has a certain lifespan, and its overall effect is ever decreasing. *It is also important to consider other finishing processes applied to a fabric or garment such as bleaching, dying, brushing or felting and others as these can be detrimental to durability and effectiveness of the essential oils. Questions remain about how processes will affect the implementation of the oils and vice versa. For example, fabrics may need to be free of other finishes before an essential oil can be applied. Fabrics may need to be de-sized, scoured, and/or bleached which could adversely affect the other performance properties of the textile. An example of this might be in the dyeing process, where the*

main concern is the correct coloration of the garment, therefore the chemistry used to dye the fabric must be exact. The herbs and the components contained within the oils could hinder or make this process more challenging. Furthermore, in the dyeing process the fabric has to be washed to clean out all the excess dye that has not bonded to the fabric. *The harsh washing process could also wash out the herbal extract limiting its effect.*

The micro-encapsulation process needs some sort of activity to release odor from the capsules. The timing of this release is vital to the usefulness of the product. The textile product may require either extra handling or more delicate handling to get the product to the consumer without causing prerelease in packaging, shipping or in retail customer handling. Also special handling or care instructions may be needed to ensure the release lasts the amount of washes the product suggests.

An issue not considered in the literature is that scented textiles require special consideration when stored. To ensure that scented textiles do not contaminate each other, objects must be physically isolated in suitable packaging. Destroying or diluting a textile scent occurs during wearing, airing, washing, and dry cleaning. *Correct selection of oils with choice of fabric must be considered and depends very much on the end use of the garment, for example; active wear garments would use distinctly different oils than pillowcases.*

All fabrics take up oils or odors differently. We need a better understanding of which fabrics are better receptors and releasers of oils and scents. How can the right fragrance be matched with other performance aspects of the fabric such as active wear to enhance the user experience? From a consumer perspective, separation of the psychological from the pharmacological is an interesting challenge. These potential applications encompass existing consumer product categories and point the way to new ones. Products that address consumer well-being are not necessarily pharmaceuticals, nor would they be marketed as drugs. Yet with some imaginative marketing, these hold the promise of becoming the next important consumer sector innovation (Gilbert & Firestein, 2002).

The desire for a healthier and more productive lifestyle will continue to generate a market for textiles that promote well-being. The textile industry must continue to be outward looking and develop textiles that 'interact' with the consumer, reducing stress, promoting comfort and relaxation (Nelson, 2002).

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