Medical Textiles and Aromatherapy

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Contributor: Sunidhi Mehta

Studies on aromatherapy and textiles published between 2011–2021 were examined to explore “textile” materials as a possible carrier for essential oils. Essential oil-based bio-functional textiles for biocidal applications and therapeutic effects are reviewed.

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1. Bio-engineered products

The scope and usefulness of bio-engineered products have increased tremendously in the recent past and textile materials offer an excellent medium to carry these bio-engineered products for human health and welfare [1]. Their niche application specifically in the areas of the medical and defense industries have caught the attention of both researchers and industry. Medical textiles have two broad approaches as (I) Implantable devices, and (II) Bio-functional textiles. The former includes vascular prostheses, suture threads, stents, substitutes of tendons, etc., and the latter includes textiles with value-added functions [2].

2. Bio-Functional Textiles

The bio-functional textiles have several functions including but not limited to antibacterial, antiviral, anti-inflammatory, and biomedical applications such as wound dressing, healing, and organ-regenerative properties [3]. They can also be used for filtering, protection, organ strengthening, replacing failing organs, supporting tissue regeneration, and preventing postoperative complications, applications that have been useful in the pharmacological industry. Due to the prolonged and close contact of fabric with the skin, textile materials can be an excellent drug delivery system.

Apart from their usual function of providing a protective layer to the body, these bio-functional textiles protect the wearer from environmental pathogens and can have a direct therapeutic effect on the body. For example, a pharmacological drug or plant-based active ingredient can be delivered from textiles directly to the body and these therapeutic textiles can provide an effective therapeutic function to the wearer, such as “antiallergic” or “antipsoriasis” effects. The essential oil-based bio-functional textiles can be used either for *biocidal* (antibacterial, antiviral, antifungal, and insect repellent) applications or *therapeutic* effects [4][5]. Rose and sage essential oils present the highest applicability in the functions of biocidal and traditional medicine [6][7]. The dominant compound of sage essential oil, 1,8-cineole, is known for its antifungal and antimicrobial properties, while rose EO has shown efficacy against anxiety, depression, and stress-related conditions [8].

In another study, bio-active textiles were impregnated with econazole nitrate (ECN), an active ingredient for the treatment of fungal infections [9]. The thermosensitive microcapsules loaded with ECN released the drug during contact with the skin. The antifungal activity was reported to be comparable to the topical application of the ECN-based topical cream for fungal infection treatment. The ECN-based textiles were reported to show antifungal activity against a wide-ranging fungal strain in vitro and in vivo. These textiles enable high therapeutic efficacy against *cutaneous candidiasis* in mice. Such pharmacological applications of textiles show a promising future for biomedical textiles for treating fungus-related skin conditions.

Textiles coated with esterificated citric acid also brought about significant improvement in atopic eczema symptoms in both objective and subjective analyses of 20 patients [10]. Over the last decade, there have been several new developments in the therapeutic potential of textiles such as silver-coated textiles, seaweed-infused fabrics, and chitosan-impregnated textiles as an alternative to medical treatment in milder cases of skin conditions such as atopic eczema and other fungal infections.

3. Biocidal applications

The EO obtained from *Iryanthera Polyneura* (an Amazonian plant commonly known as cumala-colorada) were studied for their antimicrobial activity against selected pathogens such as *Candida albicans*, *Enterococcus faecalis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Streptococcus mutans* and *S. sanguinis*. Spathulenol, *α*-cadinol and *τ*-muurolol were major components of the EO. The oil showed promising antimicrobial activity against *E. faecalis*, *S. aureus* and PC-3, when collected in the dry season. However, the oils obtained from leaves collected in the rainy season were more active against *S. mutans* and *S. sanguinis*. The antibacterial activities of the essential oils from the leaves of *I. polyneura* are related to seasonal climate variation and are influenced by compounds that are minor components of the oils. Another example of such bio-functional textiles is mosquito repellent textile. Mosquitoes such as *Anopheles Meigen*, *Culex* L., and *Haemagogus* L. are responsible for the transmission of several tropical diseases such as malaria, hemorrhagic dengue, yellow fever, and filariasis. Traditional sources of mosquito repellents can be found in plant-based essential oils, and there are currently 144 active patents in this area [11]. Essential oils reported assisting the mosquito repellent function include cinnamon, citronella, eucalyptus, lavender, peppermint, clove, lemongrass, germanium, camphor, lemon, chamomile, jasmine, juniper, verbena, and wild soybean. Textiles infused with essential oils to perform a mosquito repellent function are not only effective in their intended function but also provide a sustainable approach to repel mosquitoes.

4. Therapeutic Applications

Value-added functional textiles for human well-being and comfort continue to increase in popularity, particularly the aromatherapy-based textile treatments that manipulate our olfactory senses and provide therapeutic benefits. The essential oils are generally microencapsulated and coated on textile surfaces to develop functional textiles with medicinal and antimicrobial properties [12][13]. For instance, lemon oil-infused textiles provided psychological and sensorial comfort, while patchouli oil, *Artemsia argyi oil,* and moxa oil, when applied to textiles, showed eco-friendly antibacterial activity [14]. It is believed that such antibacterial textiles provide a therapeutic function to heal infection-induced skin diseases and create a wound-healing mechanism to improve the overall health of the skin. However, biocidal effects, such as antibacterial/antiviral/antifungal effects, are more popular applications when it comes to biofunctional textiles infused with micro/nano encapsulated EOs. In the research literature to date, there is rarely an emphasis on the “therapeutic” effect of aromatherapeutic textiles. Further research using clinical trials with a focus on assessing the therapeutic benefits of aromatherapeutic textiles is needed.

5. Conclusion

The literature on aromatherapy and textiles reveals a host of studies from a wide variety of fields that can collectively be seen as encouraging to the premise that textiles may be a suitable medium for enhancing the human experience.

In the 21st century, textiles as our nearest environment have demonstrated the potential to serve as a conduit for the transdermal delivery and controlled release of a host of health-related compounds to patients and individuals for enhancing health and well-being. Innovations in imprinting or embedding textiles with bioactive compounds are leading to dermal treatments for bacterial, allergic, fungal, and other compromising health conditions. Some of the suggested applications for such textiles are antibacterial masks, bacteriostatic sheets, and healthcare apparel. The potential for health or medical-related textile products is enormous but more research is needed to take the current state of knowledge forward to define the specific therapeutic benefits of the EOs utilized. The synergy between related fields of knowledge must come about to better understand the efficacy of aromatherapeutic textiles.

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