**Name of Journal: *World Journal of Dermatology***

**ESPS Manuscript NO: 30881**

**Manuscript Type: Minireviews**

**Cutaneous implications of essential oils**

Vangipuram R *et al.* Cutaneous implications of essential oils

**Ramya Vangipuram, Lisa Mask-Bull, Soo Jung Kim**

**Ramya Vangipuram,** Center for Clinical Studies, Webster, TX 77598, United States

**Lisa Mask-Bull, Soo Jung Kim,** Department of Dermatology, Texas Tech University Health Sciences Center, Lubbock, TX 79430, United States

**Author contributions:** Vangipuram R, Mask-Bull L and Kim SJ contributed equally to this work; Vangipuram R wrote the paper; Mask-Bull L developed the idea and designed the outline; Kim SJ performed a critical revision of the manuscript.

**Conflict-of-interest statement:** All authors declare no conflict of interest.

**Open-Access:** This article is an open-access article which was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/

**Manuscript source:** Invited manuscript

**Correspondence to:** **Ramya Vangipuram, MD,** Center for Clinical Studies, 451 N. Texas Ave, Webster, TX 77598, United States. rvangip@gmail.com

**Telephone:** +1-281-3332288-1109

**Fax:** +1-281-3334605

**Received:** October 20, 2016

**Peer-review started:** October 24, 2016

**First decision:** December 1, 2016

**Revised:** January 8, 2017

**Accepted:** February 10, 2017

**Article in press:**

**Published online:**

**Abstract**

Essential oils (EOs) as home remedies and for health benefits have been used for millennia, but with the recent surge in the popularity of natural products, these oils have garnered increased attention. EOs are complex natural mixtures obtained plant materials, and have demonstrated potent biological effects in vitro. They have commercial value in the food, cosmetics, and fragrance industries, and also have also experienced a steady rise in personal and home use as part of aromatherapy. Currently, widespread acceptance and use of EOs is limited by a lack of large-scale clinical trials in humans. In addition, they are associated with notable side effects such as contact and allergic dermatitis, among a myriad of rare but serious systemic side effects. This review is intended to provide the clinician with key background information and biology of essentials oils, identify key trials demonstrating benefits, and describe adverse effects, with a focus on cutaneous presentations.

**Key words:** Essential oils; Aromatherapy; Photosensitization; Contact dermatitis

**© The Author(s) 2017.** Published by Baishideng Publishing Group Inc. All rights reserved.

**Core tip:** Essential oils (EOs) have been used as home remedies for millennia. Currently, widespread acceptance and use of EOs is limited by a lack of large-scale clinical trials in humans. In addition, EOs are associated with notable side effects such as contact and allergic dermatitis, among a myriad of rare but serious systemic side effects. We review the current usage of EOs and identify pertinent cutaneous manifestations.

Vangipuram R, Mask-Bull L, Kim SJ. Cutaneous implications of essential oils. *World J Dermatol* 2017; In press

**INTRODUCTION**

Essential oils (EOs) are complex volatile substances extracted from plants, and used in food, cosmetic, and fragrance industries. They have gained the attention of the medical community for their biologically active effects and therapeutic potential for many illnesses. In addition, EOs are also experiencing a tremendous growth in aromatherapy and home use for their reported health benefits[1]. EOs are well-known allergens and photosensitizers; however, there is a paucity of data on the dermal exposure of essential oil use in the United States. In addition, the production and use of EOs is not currently standardized or regulated and may pose an occupational hazard for those with close and repeated contact with EOs. With increasing popularity of essential oil consumption, clinicians can expect to come across more cases of cutaneous and systemic reactions to these complex substances. This review provides the most updated and relevant scientific information related essential oil use, primarily pertaining to cutaneous involvement.

**BACKGROUND**

EOs are secondary metabolites found in plants[1]. They are derived from plant material, such as leaves, stems, flowers, bark, and roots[1]. Common methods used to extract the components include steam distillation, or mechanical expression; oils produced with the aid of chemical solvents are not considered true EOs[1]. The major chemical composition of EOs includes terpenes, esters, aldehydes, ketones, alcohols, phenols, and oxides[2]. A given essential oil contains varying amounts of each of these compounds, which imparts a particular fragrance and determines its therapeutic characteristics[2]. In contrast, a fragrance is chemically made to mimic the smell of a plant or flower.

EOs can be divided into two main distinct biosynthetic origins: The terpenes and terpenoids, and the aromatic and aliphatic components[3].There is great interest in the main biologically active component of EOs - terpenes and terpenoids. Terpenes are a large and diverse class of organic compounds that consist of five-carbon bases[4]. Some terpenes, such as the diterpenes, are the building blocks for biologically active compounds such as retinol, retinal, and taxol[1]. Diterpenoids have antioxidant, antimicrobial, anticancer, anti-inflammatory, wound healing, antihypertensive, analgesic, and anxiolytic activities[5-7].

**APPLICATIONS OF EOS**

Currently, of the approximately 3000 EOs that have been described, 300 are commercially important[8,9]. The use of EOs is common in food flavoring, fragrance, and cosmetic industries. The United States Food and Drug administration has classified most EOs as “generally recognized as safe” at specified concentration limits[3].

EOs comprise the key ingredient in aromatherapy, which is rapidly growing in popularity worldwide[10-13]. Many spas, massage therapists, and practitioners of alternative medicine provide aromatherapy. The most commonly used EOs in aromatherapy include patchouli, cedarwood, lavender, tea tree oil, along with citrus-scented oils such as bergamot, lemon, and orange oils (Table 1). The oils are usually applied to the skin, but can also be given orally, by inhalation, or by diffusion through the air. Currently, aromatherapy products do not need approval by the FDA[13].

Little is known about consumption habits and exposure to EOs, especially in the United States. The most comprehensive study of usage patterns was a 2014 study, which focused on the 12 most types of EOs among 1507 participants in France[14]. Information about types of EOs used, skin areas exposed, frequencies and quantities were collected. Lavender (Lavanda) species are the most used EOs among both females and males, followed by Eucalyptus oil (Table 2)[14]. The study notably pointed out the increased prevalence of female users for almost all types of Eos[14]. In addition, females tend to apply EOs on their face and neck, while males applied the products on the chest[14].

**MEDICINAL USES**

EOs are composed of many biologically active molecules, which may have promising therapeutic benefits in many diseases and ailments. EOs have been recognized for their antibacterial, antiviral, antifungal, and insecticidal properties, which led to their acceptance and wide-spread use in the food industry[15-19].Pre-clinical studies have shown that in addition to aforementioned properties, EOs also demonstrate potent anti-inflammatory, and antioxidant activity[20-22]. Because of the great number and variety of constituents, EOs do not have specific cellular targets. They exert their cytotoxic effects through disruptions in the structure and functions of key intracellular lipids and proteins[2]. In eukaryotic cells, EOs can change the fluidity of membranes, which become abnormally permeable resulting in leakage of radicals, cytochrome C, calcium ions and proteins[2]. Permeabilization of outer and inner mitochondrial membranes leads to cell death through apoptosis and necrosis[2].Similar cytotoxic effects were observed in vitro in many gram positive and gram negative bacteria of relevance to the food industry including *S. aureus* and *E. coli*[2].

***Bottom of form***

Of all the EOs, tea tree oil (TTO) is arguably the most recognized and investigated compound in dermatology. Numerous studies have demonstrated its tolerability and efficacy and against *P. acnes*[22-24]*.* A 1990 singe-blind randomized controlled trial (RCT) in 124 patients showed that 5% TTO gel has a comparable efficacy to that 5% benzoyl peroxide lotion[22]. In 2007, a double-blind RCT was performed in 60 patients with mild to moderate facial acne vulgaris[23]. A significant difference between TTO gel and placebo was observed based on decreases in total lesion counts and acne severity index scores[23]. Most recently, the results of a 2016 phase II pilot study assessing tea tree oil for the treatment of mild to moderate acne further demonstrated its efficacy, and favorable side-effect profile[24]. No serious adverse events were reported in this study and side effects were limited to self-resolving peeling, dryness and scaling[24]. In addition, tea tree oil has shown promising results for other common dermatologic ailments such as seborrheic dermatitis[25-27]. A 2002 single-blind parallel controlled trial of 126 patients with mild to moderate dandruff showed that the use of 5% TTO shampoo showed 41% improvement in dandruff, as measured by quadrant-area-severity score, compared with 11% in the placebo group (*P* < 0.001)[27].

EOs have also been studied for the treatment of alopecia areata. A double-blind RCT involving 86 patients showed that a mixture of thyme, rosemary, lavender, and cedarwood EOs massaged into patients' scalps produced significant improvement when compared with the carrier oils alone (improvement in 54% and 21% of patients, respectively, *P* = 0.08)[28]. The efficacy of the treatment was evaluated at initial assessment and 3 and 7 mo after treatment by dermatologists’ visual scoring of photographs and a computerized analysis of traced areas of alopecia[28]. However, the study had limited external validity, as the extent and severity of the alopecia areata in the subjects were not mentioned. At this time, there are no further clinical trials using EOs for alopecia areata.

There is little doubt that EOs may have great relevance to the field of dermatology, and more studies should be performed given all of their *in vitro* findings. Further work on the antimicrobial, antiviral and antifungal effects of EOs may have immense potential in the treatment of dermatological diseases. Indeed, a 2012 study showed that a combination of TTO with iodine was superior to iodine alone in the treatment of molluscum contagiosum virus in 53 children[29]. Moreover, EOs may have benefits in other cutaneous maladies, such as hyperpigmentation. The efficacy of α-bisabolol, a terpene derivative of the essential oil of *Matricaria chamomilla,* exerts an inhibitory effect on melanogenesis[30]. In a 2010 study, α-bisabolol was evaluated in an 8-week clinical trial of 28 Asian females, and led to a significant decrease in hyperpigmentation[31].

**ADVERSE EFFECTS**

While safety testing on EOs has shown minimal adverse effects, the use of EOs still poses risks and allergic responses that clinicians should be aware of. Under normal conditions of established use, most oils appear to have a good safety profile[12]. The majority of adverse events are mild, but serious toxic reactions from some EOs have been observed, including abortions or abnormalities in pregnancy, neurotoxicity manifesting as seizures or retardation of infant development, bronchial hyperreactivity, and hepatotoxicity[12]. Accidental ingestion by young children has occasionally proved fatal[32]. Repeated exposure to topical lavender and tea tree oils was associated with the development of prepubertal gynecomastia in a case-series of 3 subjects[33]. This outcome was reversible upon discontinuation of the oils, and was attributed to the mild estrogenic and anti-androgenic activities of lavender and tea tree oils[33].

Notably, the majority of adverse effects of EOs are cutaneous in nature. The field of dermatology has encountered an increase in the frequency of allergic reactions to EOs, likely secondary to the growing popularity of topical use of EOs[12]. EOs are known sensitizers, and there is extensive evidence linking them to cases of contact allergy and allergic contact dermatitis[34,35]. One case of airborne contact dermatitis secondary to sensitization after inhaled aromatherapy has also been described[36]. As EOs age, they are often oxidized so their chemical composition changes, and may become more allergenic or prone to irritation[13]. The most common allergens are ylang-ylang oils, lemongrass oil, jasmine absolute, sandalwood oil, and clove oil[13]. However, in clinical practice, it may be difficult to identify specific EOs in many cases. For example, in aromatherapy, the practitioner commonly uses undefined mixtures of EOs without specifying the plant sources.

In addition, many EOs contain chemicals prone to causing sensitization, including limonene, linalool, citral, and cinnamyl alcohol (Table 3)[14]. This is most commonly seen with citrus oils, such as bergamot, lemon, lime, and orange, which contain foucoramins, in addition to limonene, linalool, and citral. Linalool, a terpene derivative found in many EOs, is the most sensitizing components in many EOs[36]. It is a fragrant chemical also found in lavender, ylang-ylang, and jasmine oils[36]. Cinnamyl alcohol is found in patchouli oil[15]. Factors influencing risk of photo-sensitization also include the amount of product applied and the area of exposure. This is important as the major study determining exposure patterns of topical essential oil use found that females tend to apply to areas such as the face and neck, thus placing themselves at greater risk of photosensitive reactions[14].

**NEED FOR FURTHER RESEARCH**

Although it is well established that allergic contact dermatitis can result from essential oil use, the allergens in EOs are largely unknown. Moreover, patch testing currently does not provide accurate or particularly reliable information on EOs, as many EOs lack standardization in manufacturing and production[37]. Finally, larger scale studies on exposure patterns are needed to reliably estimate the use of EOs. Many patients struggle with chronic cutaneous diseases and often wish to try to “natural” or “alternative” therapies, without being aware of the potential allergenic side effects.

**CONCLUSION**

The use of EOs, which are complex volatile substances with strong odors, has long been established in the fragrance and cosmetic industries. In addition, EOs have notable effects as antimicrobial agents, and are widely used in food industries. In recent times, EOs in the form of aromatherapy have experienced a resurgence in their popularity. They are notable for causing allergic and photosensitivity reactions, along with serious but rarely occurring side effects. More controlled clinical studies are needed to determine the benefits and risks of plant-derived products, especially EOs, in dermatology. This review describes historical and current results from scientific studies of essential oil components and highlights the areas in need of further research.

**REFERENCES**

1 **Islam MT**, da Mata AM, de Aguiar RP, Paz MF, de Alencar MV, Ferreira PM, de Carvalho Melo-Cavalcante AA. Therapeutic Potential of Essential Oils Focusing on Diterpenes. *Phytother Res* 2016; **30**: 1420-1444 [PMID: 27307034 DOI: 10.1002/ptr.5652]

2 **Bakkali F**, Averbeck S, Averbeck D, Idaomar M. Biological effects of essential oils--a review. *Food Chem Toxicol* 2008; **46**: 446-475 [PMID: 17996351 DOI: 10.1016/j.fct.2007.09.106]

3 **Pichersky E**, Noel JP, Dudareva N. Biosynthesis of plant volatiles: nature's diversity and ingenuity. *Science* 2006; **311**: 808-811 [PMID: 16469917 DOI: 10.1126/science.1118510]

4 **Llana-Ruiz-Cabello M**, Pichardo S, Maisanaba S, Puerto M, Prieto AI, Gutiérrez-Praena D, Jos A, Cameán AM. In vitro toxicological evaluation of essential oils and their main compounds used in active food packaging: A review. *Food Chem Toxicol* 2015; **81**: 9-27 [PMID: 25865936 DOI: 10.1016/j.fct.2015.03.030]

5 **Devappa RK**, Makkar HPS, Becker K. 2011. Jatropha diterpenes: a review. *J Am Oil Chem Soc* 2011; **88**: 301-303 [DOI: 10.1007/s11746-010-1720-9]

6 **Cheenpracha S**, Yodsaoue O, Karalai C, Ponglimanont C, Subhadhirasakul S, Tewtrakul S, Kanjana-opas A. Potential anti-allergic ent-kaurene diterpenes from the bark of Suregada multiflora. *Phytochemistry* 2006; **67**: 2630-2634 [PMID: 17095024 DOI: 10.1016/j.phytochem.2006.09.031]

7 **Cho JH**, Lee JY, Sim SS, Whang WK, Kim CJ. Inhibitory effects of diterpene acids from root of Aralia cordata on IgE-mediated asthma in guinea pigs. *Pulm Pharmacol Ther* 2010; **23**: 190-199 [PMID: 20060054 DOI: 10.1016/j.pupt.2009.12.004]

8 **Gyawali R**, Ibrahim SA. Natural products as antimicrobial agents. *Food Contr* 2014: 12-29 [DOI: 10.1016/j.foodcont.2014.05.047]

9 **Hyldgaard M**, Mygind T, Meyer RL. Essential oils in food preservation: mode of action, synergies, and interactions with food matrix components. *Front Microbiol* 2012; **3**: 12 [PMID: 22291693 DOI: 10.3389/fmicb.2012.00012]

10 **Rhind JP**. Essential Oils. A Handbook for Aromatherapy Practice. 2nd ed. London: Singing Dragon, 2012

11 **Lawless J**. The Encyclopedia of Essential Oils. 2nd ed. London: Harper Thorsons, 2014

12 **de Groot AC**, Schmidt E. Essential Oils, Part I: Introduction. *Dermatitis* 2016; **27**: 39-42 [PMID: 26983089 DOI: 10.1097/DER.0000000000000175]

13 Aromatherapy and Essential Oils (PDQ®): Health Professional Version. PDQ Integrative, Alternative, and Complementary Therapies Editorial Board. Bethesda (MD): National Cancer Institute (US); 2002-2016 Apr 8 [PMID: 26389313]

14 **Dornic N**, Ficheux AS, Roudot AC, Saboureau D, Ezzedine K. Usage patterns of aromatherapy among the French general population: A descriptive study focusing on dermal exposure. *Regul Toxicol Pharmacol* 2016; **76**: 87-93 [PMID: 26826550 DOI: 10.1016/j.yrtph.2016.01.016]

15 **Sung SY**, Sin LT, Tee TT Soo-Tueen B, Rahmat AR, Rahman WA, Ann-Chen T, Vikhraman K. Antimicrobial agents for food packaging applications. *Trends Food Sci Technol* 2013; **33**: 110-123 [DOI: 10.1016/j.tifs.2013.08.001]

16 **Angioni A**, Barra A, Coroneo V, Dessi S, Cabras P. Chemical composition, seasonal variability, and antifungal activity of Lavandula stoechas L. ssp. stoechas essential oils from stem/leaves and flowers. *J Agric Food Chem* 2006; **54**: 4364-4370 [PMID: 16756368 DOI: 10.1021/jf0603329]

17 **Bajpai VK**, Baek KH, Kang SC. Control of Salmonella in foods by using essential oils: a review. *Food Res Int* 2012; **45**: 722-734 [DOI: 10.1016/j.foodres.2011.04.052]

18 **Abbaszadeh G**, Srivastava C, Walia S. Insecticidal and antifeedant activities of clerodane diterpenoids isolated from the Indian bhant tree, Clerodendron infortunatum, against the cotton bollworm, Helicoverpa armigera. *J Insect Sci* 2014; **14**: 29 [PMID: 25373176 DOI: 10.1093/jis/14.1.29]

19 **Tang W**, Wei X, Xu H, Zeng D, Long L. 13-Deoxyitol A, a new insecticidal isoryanodane diterpene from the seeds of Itoa orientalis. *Fitoterapia* 2009; **80**: 286-289 [PMID: 19318121 DOI: 10.1016/j.fitote.2009.03.006]

20 **Roby MHH**, Sarhana MA, Selima KAH, Khalela KI. Evaluation of antioxidant activity, total phenols and phenolic compounds in thyme (Thymus vulgaris L.), sage (Salvia officinalis L.), and marjoram (Origanum majorana L.) extracts. *Ind Crops Prod* 2013; **43**: 827-831 [DOI: 10.1016/j.indcrop.2012.08.029]

21 **Teixeira B**, Marques A, Ramos C, Batista I, Serrano C, Matos O, Neng NR, Nogueira J, Saraiva JA, Nunes ML. European pennyroyal (Mentha pulegium) from Portugal: chemical composition of essential oil and antioxidant and antimicrobial properties of extracts and essential oil. *Ind Crops Prod* 2012; **36**: 81-87 [DOI: 10.1016/j.indcrop.2011.08.011]

22 **Bassett IB**, Pannowitz DL, Barnetson RS. A comparative study of tea-tree oil versus benzoylperoxide in the treatment of acne. *Med J Aust* 1990; **153**: 455-458 [PMID: 2145499]

23 **Enshaieh S**, Jooya A, Siadat AH, Iraji F. The efficacy of 5% topical tea tree oil gel in mild to moderate acne vulgaris: a randomized, double-blind placebo-controlled study. *Indian J Dermatol Venereol Leprol* 2007; **73**: 22-25 [PMID: 17314442]

24 **Malhi HK**, Tu J, Riley TV, Kumarasinghe SP, Hammer KA. Tea tree oil gel for mild to moderate acne; a 12 week uncontrolled, open-label phase II pilot study. *Australas J Dermatol* 2016; Epub ahead of print [PMID: 27000386]

25 **Gupta AK**, Nicol K, Batra R. Role of antifungal agents in the treatment of seborrheic dermatitis. *Am J Clin Dermatol* 2004; **5**: 417-422 [PMID: 15663338]

26 **Waldroup W**, Scheinfeld N. Medicated shampoos for the treatment of seborrheic dermatitis. *J Drugs Dermatol* 2008; **7**: 699-703 [PMID: 18664167]

27 **Satchell AC**, Saurajen A, Bell C, Barnetson RS. Treatment of dandruff with 5% tea tree oil shampoo. *J Am Acad Dermatol* 2002; **47**: 852-855 [PMID: 12451368 DOI: 10.1067/mjd.2002.122734]

28 **Hay IC**, Jamieson M, Ormerod AD. Randomized trial of aromatherapy. Successful treatment for alopecia areata. *Arch Dermatol* 1998; **134**: 1349-1352 [PMID: 9828867]

29 **Markum E**, Baillie J. Combination of essential oil of Melaleuca alternifolia and iodine in the treatment of molluscum contagiosum in children. *J Drugs Dermatol* 2012; **11**: 349-354 [PMID: 22395586]

30 **Kim S**, Lee J, Jung E, Huh S, Park JO, Lee JW, Byun SY, Park D. Mechanisms of depigmentation by alpha-bisabolol. *J Dermatol Sci* 2008; **52**: 219-222 [PMID: 18692366 DOI: 10.1016/j.jdermsci.2008.06.005]

31 **Lee J**, Jun H, Jung E, Ha J, Park D. Whitening effect of alpha-bisabolol in Asian women subjects. *Int J Cosmet Sci* 2010; **32**: 299-303 [PMID: 20642768 DOI: 10.1111/j.1468-2494.2010.00560.x]

32 **Tisserand R**, Young R. Essential Oil Safety. 2nd ed. Churchill Livingstone Elsevier, 2014

33 **Henley DV**, Lipson N, Korach KS, Bloch CA. Prepubertal gynecomastia linked to lavender and tea tree oils. *N Engl J Med* 2007; **356**: 479-485 [PMID: 17267908 DOI: 10.1056/NEJMoa064725]

34 **Bilsland D**, Strong A. Allergic contact dermatitis from the essential oil of French marigold (Tagetes patula) in an aromatherapist. *Contact Dermatitis* 1990; **23**: 55-56 [PMID: 2401143]

35 **Lapeere H**, Boone B, Verhaeghe E, Ongenae K, Lambert J. Contact dermatitis caused by lovage (Levisticum officinalis) essential oil. *Contact Dermatitis* 2013; **69**: 181-182 [PMID: 23948036 DOI: 10.1111/cod.12082]

36 **Schaller M**, Korting HC. Allergic airborne contact dermatitis from essential oils used in aromatherapy. *Clin Exp Dermatol* 1995; **20**: 143-145 [PMID: 8565250]

37 **Hagvall L**, Christensson JB. Patch Testing with Main Sensitizers Does Not Detect All Cases of Contact Allergy to Oxidized Lavender Oil. *Acta Derm Venereol* 2016; **96**: 679-683 [PMID: 26671837 DOI: 10.2340/00015555-2319]

**P-Reviewer:** Chen GS, Kaliyadan F, Manolache L, Vasconcellos C **S-Editor:** Ji FF **L-Editor: E-Editor:**

**Table 1 Commonly used essential oils (botanical origin)**

|  |
| --- |
| Tea tree oil (*Melaleuca alternifolia*) |
| Jasmine absolute (*Jasminum officinale*) |
| Sweet bay (Laurel) oil (*Laurus nobilis*) |
| Cedarwood oil (*Juniperus virginiana*) |
| Patchouli oil (*Pogostemon cablin*) |
| Ylang-ylang oil (*Cananga odorata*) |
| Lemongrass oil (*Cymbopogon* spp.) |
| Clove oils (*Eugenia caryophyllus*) |
| Jasmine absolute (*Jasminum officinale*) |
| Sweet bay (Laurel) oil (*Laurus nobilis*) |
| Neroli oil (*Citrus aurantium* flower) |
| Peppermint oil (*Mentha piperita*) |
| Narcissus absolute (*Narcissus poeticus* Flower Extract) |
| Lemon oil (*Citrus medica limonum*) |
| Eucalyptus oil (*Eucalyptus globulus*) |
| Orange oil (*Citrus aurantium dulcis*) |

**Table 2 Usage patterns of essential oils by gender (percentage of use)**

|  |  |  |
| --- | --- | --- |
|  | Females | Males |
|  |  |  |
| Essential Oils | Lavender (60%) | Lavender (50%)  |
|  | Eucalyptus (35%) | Eucalyptus (42%) |
|  | Menthol (28%) | Ylang ylang (21) |
|  | Ylang ylang (28%) | Tea Tree (19%) |
|  | Tea Tree (24%) | Citrus (19%) |
|  | Citrus (24%) | Menthol (18%) |
|  | Vanilla (17%) | Vanilla (16%) |
|  | Rosemary (16%) | Pine (15%) |
|  | Ravintsara (16%) | Rosemary (14%) |
|  | Pine (11%) | Neroli (9%) |

**Table 3 List of commonly used essential oils (botanical origin) and allergenic ingredients**

|  |  |
| --- | --- |
| Ylang-ylang oil (*Cananga odorata*) | Linalool, Benzyl benzoate, Benzyl salicylate, Geraniol, Isoeugenol, Eugenol |
| Lemongrass oil (*Cymbopogon* spp.) | Citral, Geraniol, Limonene, Trans-isocitral, Eugenol, Linalool |
| Clove oils (*Eugenia caryophyllus*) | Eugenol, Isoeugenol |
| Jasmine absolute (*Jasminum officinale*) | Benzyl benzoate, Linalool, Eugenol, Benzyl salicylate, Isoeugenol |
| Sweet bay (Laurel) oil (*Laurus nobilis*) | Linalool, Limonene, Eugenol, Geraniol |
| Neroli oil (*Citrus aurantium* flower) | Linalool, Limonene, Geraniol, Citral |
| Peppermint oil (*Mentha piperita*) | Menthol, Limonene, Linalool |
| Narcissus absolute (*Narcissus poeticus* Flower Extract) | Benzyl benzoate, Cinnamyl alcohol, Isoeugenol |
| Lemon oil (*Citrus medica limonum*) | Limonene, Citral, Linalool, Geraniol |
| Eucalyptus oil (*Eucalyptus globulus*) | Limonene |
| Orange oil (*Citrus aurantium dulcis*) | Limonene, Linalool, Citral |
| Patchouli oil (*Pogostemon cablin*) | Cinnamyl alcohol |