Essential Oils and Skin Research

MRSA

An example of one the many studies showing the effectiveness of essential oils against Staph infections of the skin.

BMC Complement Altern Med. 2012 Aug 16;12:125. doi: 10.1186/1472-6882-12-125.

Application of orange essential oil as an antistaphylococcal agent in a dressing model.

Abstract

BACKGROUND:

Staphylococcus aureus is the pathogen most often and prevalently involved in skin and soft tissue infections. In recent decades outbreaks of methicillin-resistant S. aureus (MRSA) have created major problems for skin therapy, and burn and wound care units. Topical antimicrobials are most important component of wound infection therapy. Alternative therapies are being sought for treatment of MRSA and one area of interest is the use of essential oils. With the increasing interest in the use and application of natural products, we screened the potential application of terpeneless cold pressed Valencia orange oil (CPV) for topical therapy against MRSA using an in vitro dressing model and skin keratinocyte cell culture model.

METHODS:

The inhibitory effect of CPV was determined by disc diffusion vapor assay for MRSA and vancomycin intermediate-resistant S. aureus (VISA) strains. Antistaphylococcal effect of CPV in an in vitro dressing model was tested on S. aureus inoculated tryptic soya agar plate. Bactericidal effect of CPV on MRSA and VISA infected keratinocyte cells was examined by enumeration of extra- and intra-cellular bacterial cells at different treatment time points. Cytotoxic effects on human skin cells was tested by adding CPV to the keratinocyte (HEK001) cells grown in serum free KSFM media, and observed by phase-contrast microscope.

RESULTS:

CPV vapour effectively inhibited the MRSA and VISA strains in both disc diffusion vapour assay and in vitro dressing model. Compared to untreated control addition of

0.1% CPV to MRSA infected keratinocyte decreased the viable MRSA cells by 2 log CFU/mL in 1 h and in VISA strain 3 log CFU/mL reduction was observed in 1 h. After 3 h viable S. aureus cells were not detected in the 0.2% CPV treatment. Bactericidal concentration of CPV did not show any cytotoxic effect on the human skin keratinocyte cells in vitro.

CONCLUSIONS:

At lower concentration addition of CPV to keratinocytes infected with MRSA and VISA rapidly killed the bacterial cells without causing any toxic effect to the keratinocytes. Therefore, the results of this study warrant further in vivo study to evaluate the potential of CPV as a topical antistaphylococcal agent.

Skin infections

Lett Appl Microbiol. 2016 Dec;63(6):495-501. doi: 10.1111/lam.12683. Epub 2016 Nov 6.

Synergistic antimicrobial activity of Boswellia serrata Roxb. ex Colebr. (Burseraceae) essential oil with various azoles against pathogens associated with skin, scalp and nail infections.

Abstract

Antimicrobials from natural sources have gained immense importance in recent times to combat the global challenge of antibiotic resistance. Essential oils are implicated in antimicrobial action against several species. Here, we have screened nine commercially available essential oils for their antimicrobial activity against organisms associated with skin, scalp and nail infections mainly Propionibacterium acnes, Malassezia spp., Candida albicans and Trichophyton spp. Among nine essential oils, Boswellia serrata essential oil demonstrated superior antimicrobial activity against all the micro-organisms and surprisingly it showed maximum activity against Trichophyton spp. The gas chromatography-mass spectrometry analysis of B. serrata oil indicates a major composition of α thujene, ρ cymene and sabinene. Additionally, B. serrata oil was found to inhibit Staphylococcus epidermidis biofilm, and its combination with azoles has shown synergistic activity against azole-resistant strain of C. albicans. These broad-spectrum antimicrobial activities of B. serrata oil will make it an ideal candidate for topical use.

SIGNIFICANCE AND IMPACT OF THE STUDY:

Eradication of skin and nail infections still remain a challenge and there are serious concerns regarding the recurrence of the diseases associated with these infections. Antimicrobials from plant sources are gaining importance in therapeutics because they encounter minimal challenges of emergence of resistance. We have demonstrated the

antimicrobial activity of Boswellia serrata essential oil against micro-organisms involved in skin, scalp and nail infections, especially if it has shown favourable synergistic antifungal activity in combination with azoles against the azole-resistant Candida albicans strain. Thus, B. serrata oil can be one of the plausible therapeutic agents for management of skin, scalp and nail infections.

Acne

Indian J Dermatol Venereol Leprol. 2007 Jan-Feb;73(1):22-5.
The efficacy of 5% topical tea tree oil gel in mild to moderate acne vulgaris: a randomized, double-blind placebo-controlled study.
Abstract
BACKGROUND:
Finding an effective treatment for acne that is well tolerated by the patients is a challenge. One study has suggested the efficacy of tea tree oil in treatment of the acne vulgaris.
AIM:
To determine the efficacy of tea tree oil in mild to moderate acne vulgaris.
METHODS:
This was a randomized double-blind clinical trial performed in 60 patients with mild to moderate acne vulgaris. They were randomly divided into two groups and were treated with tea tree oil gel (n=30) or placebo (n=30). They were followed every 15 days for a period of 45 days. Response to treatment was evaluated by the total acne lesions counting (TLC) and acne severity index (ASI). The data was analyzed statistically using t-test and by SPSS program.
RESULTS:
There were no significant differences regarding demographic characteristics between the two groups. There was a significant difference between tea tree oil gel and placebo in the improvement of the TLC and also regarding improvement of the ASI. In terms of TLC and ASI, tea tree oil gel was 3.55 times and 5.75 times more effective than placebo respectively. Side-effects with both groups were relatively similar and tolerable.
CONCLUSION:
Topical 5% tea tree oil is an effective treatment for mild to moderate acne vulgaris.

Biomedica. 2012 Jan-Mar;32(1):125-33. doi: 10.1590/S0120-41572012000100014.
[Effectiveness of antimicrobial formulations for acne based on orange (Citrus sinensis) and sweet basil (Ocimum basilicum L) essential oils].
Abstract
INTRODUCTION:

Currently, the antimicrobial resistance has developed in bacterial strains involved in the development of acne. Therefore, alternatives to antibiotic treatment have become necessary.

OBJECTIVES:

Gel formulations were designed based on essential oils and acetic acid, and their effectiveness was evaluated in patients affected by acne.

MATERIALS AND METHODS:

Masked simple experimental study of three gel formulations on 28 volunteer patients, separated in four groups of seven patients. Treatments were applied daily for eight weeks and consisted of (1) antibacterial (essential oils), (2) keratolytic medication (3) essential oils mixed with acetic acetic, and (4) kerolytic medication with acetic acid. Weekly checks were conducted to evaluate patient improvement.

RESULTS:

All groups reported an improvement of the acne condition, which ranged between 43% and 75% clearance of lesions. Evidence of treatment disappeared within minutes, showing little discomfort or side effects after application.

CONCLUSIONS:

The essential oil formulations were chemically and physically stable during application of treatments. This was demonstrated by gas chromatography, where no evidence no change neither the composition profiles of essential oils nor in acetic acid. The results were ranked good to excellent, particularly for the acetic acid mixture, which achieved improvements of 75%. This appeared to be a result of their joint antiseptic and keratolytic activity. Side effects (burning and redness) disappeared within a few minutes of completing the application, therefore, did not interfere with adherence to treatment.

Altern Med Rev. 2012 Mar;17(1):69-75.

Application of the essential oil from copaiba (Copaifera langsdori Desf.) for acne vulgaris: a double-blind, placebo-controlled clinical trial.

Abstract

Copaiba oil-resin is widely used in traditional medicine due to its anti-inflammatory, healing, and antiseptic activities. This research aims to extract and evaluate the qualitative and quantitative composition of copaiba essential oil from the oil-resin, and test its effects, after incorporation in a gel applied in volunteers with acne, in a double-blind placebo controlled clinical trial. The essential oil was extracted by steam distillation, and purified by freezing to remove the residual remnant water. The density of the essential oil was gravimetrically determined by weighing 1 mL of liquid at 20 degree C. The identification of the essential oil components was carried out through high-resolution gas chromatography analysis, coupled with mass spectrometry. The essential oil has a density of 0.9175 mg/mL and was composed of 48 substances, 14 of

which were the major components representing 95.80% of total essential oil composition. Cis-thujopsene was the main component (46.96% of total essential oil composition). The surface affected with acne decreased when treated with placebo (F = 13.931, p = 0.001, r = 0.518; r2 = 0.268), but the linear model could explain only 26.8% of total variance in original data matrix. There was a highly significant decrease in the surface affected with acne in the areas treated with the 1.0% copaiba essential oil preparation (F = 86.494, p = 0.000, r = 0.834; r2 = 0.695).

Biosci Biotechnol Biochem. 2008 Oct;72(10):2507-13. Epub 2008 Oct 7.
Biological activities of Korean Citrus obovoides and Citrus natsudaidai essential oils against acne-inducing bacteria.
Abstract
This study was designed to analyze the chemical composition of Citrus obovoides (Geumgamja) and Citrus natsudaidai (Cheonyahagyul) oils and to test their biological activities. These citrus essential oils were obtained by steam distillation of fruits collected from Jeju Island, Korea, and were analyzed using gas chromatograph (GC)-flame ionization detectors (FID) and GC-MS. Limonene and gamma-terpinene were the major components of the two citrus species. To evaluate in vitro anti-acne activity, they were tested against Propionibacterium acnes and Staphylococcus epidermidis, which are involved in acne. The Geumgamja and Cheonyahagyul oils exhibited antibacterial activity against both P. acnes and S. epidermidis. Their effects on DPPH radical scavenging, superoxide anion radical scavenging, and nitric oxide radical were also assessed. Cheonyahagyul and Geumgamja exhibited only superoxide anion radical-scavenging activity. To assess their potential usefulness in future cosmetic product applications, the cytotoxic effects of the two oils were determined by colorimetric MTT assays using two animal cell lines: normal human fibroblasts and HaCaT cells. They exhibited low cytotoxicity at 0.1 microl/ml in both cell lines. In addition, they reduced P. acnes-induced secretion of interleukin-8 (IL-8) and tumor necrosis factor alpha (TNF-alpha) in THP-1 cells, an indication of anti-inflammatory effects. Therefore, based on these results, we suggest that Geumgamja and Cheonyahagyul essential oils are attractive acne-mitigating candidates for topical application.

Int J Cosmet Sci. 2006 Apr;28(2):125-33. doi: 10.1111/j.1467-2494.2006.00308.x.
Evaluation of in vitro antimicrobial activity of Thai basil oils and their micro-emulsion formulas against Propionibacterium acnes.
Abstract
The aim of this study was to evaluate the efficacy of Thai basil oils and their micro-emulsions, on in vitro activity against Propionibacterium acnes. An agar disc

diffusion method was employed for screening antimicrobial activity of the essential oils of Ocimum basilicum L. (sweet basil), Ocimum sanctum L. (holy basil) and Ocimum americanum L. (hoary basil) against P. acnes. Minimum inhibitory concentration (MIC) values of the basil oils were determined using an agar dilution assay. The obtained results indicated that the MIC values of sweet basil and holy basil oils were 2.0% and 3.0% v/v, respectively, whereas hoary basil oil did not show activity against P. acnes at the highest concentration tested (5.0% v/v). Gas chromatography-mass spectrometry analysis revealed that methyl chavicol (93.0%) was the major compound in sweet basil oil, and eugenol (41.5%), gamma-caryophyllene (23.7%) and methyl eugenol (11.8%) were major compounds in holy basil oil. Hoary basil oil contained high amounts of geraniol (32.0%) and neral (27.2%) and small amounts of methyl chavicol (0.8%). The Oil-in-water (o/w) micro-emulsions of individual basil oils with concentrations corresponding to their MIC values were formulated. The stable o/w micro-emulsion system for basil oil consisted of 55.0% v/v water phase, 10.0% v/v oil phase (2.0 or 3.0% v/v sweet basil or 3.0% v/v holy basil oil plus 7.0% v/v isopropyl myristate), 29.2% v/v polysorbate 80 and 5.8% v/v 1,2-propylene glycol. Hydroxyethylcellulose at a concentration of 0.5% w/v was used as thickening agent. According to the disc diffusion assay, the formulations containing sweet basil oil exhibited higher activity against P. acnes than those containing holy basil oil, and the thickened formulations tended to give a lower activity against P. acnes than the non-thickened formulations. The prepared micro-emulsions were stable after being tested by a heat-cool cycling method for five cycles. These findings indicate the possibility to use Thai sweet and holy basil oil in suitable formulations for acne skin care.

Pharm Dev Technol. 2005;10(4):479-87.

Solid lipid microparticles (SLM) containing juniper oil as anti-acne topical carriers: preliminary studies.

Abstract

Solid lipid microparticles (SLM) were used as carriers of juniper oil and proposed for the topical treatment of acne vulgare. The formulations were obtained by the o/w emulsification method. Compritol and Precirol were employed as lipidic materials. Emulsions containing 1.5% (w/w) of lipophilic phase (lipid and oil) and two different lipid to oil ratios (1:1 and 2:1) were prepared. Blank particles were also prepared, as a comparison. The SLM were characterized in terms of encapsulation efficiency, size, and morphology. The particle size stability in aqueous dispersions was monitored over one month. Evaporation of volatile compounds of oil from microparticles by weight loss was investigated. The qualitative composition of Juniper oil before and after the encapsulation process was determined by gas chromatography (GC) and gas chromatography/mass spectrum (GC/MS) analyses. The antimicrobial activity of the oil

encapsulated into the lipid microparticles against P. acnes was studied as contact time assay and compared to the activity of the oil not encapsulated. The emulsification method here described was a good technique for the encapsulation of essential oils. Percentage yields of production and encapsulation efficiencies were higher for Compritol preparations than for these prepared using Precirol. All preparations were characterized by similar particle size distributions (dvs about 3-4 microm) regardless of lipid type and lipid to oil ratios. Microscopy observations showed that the microparticles in aqueous dispersions had almost spherical shape, independently from their composition. The scanning electron microscopy (SEM) analyses showed that when the particles were dried, they had an irregular shape and a rough surface. The SLM dispersions based on Compritol revealed particle size stability over the investigated period of 30 days. In contrast, an increase of the mean dimensions in the preparations containing Precirol was observed. A low loss of volatile oil compounds owing to evaporation from dry particles was found in all preparations. This indicated that the microparticles were able to substantially maintain the oil loaded inside their lipidic structure, reducing its volatility. Some modifications of composition were found in the oil encapsulated in SLM with respect to the juniper oil raw material, but these modifications did not decrease the antibacterial activity of the oil. The SLM here described are promising carriers for the development of anti-acne topical formulations containing Juniper oil.

Lett Appl Microbiol. 1995 Oct;21(4):242-5.

Antimicrobial effects of tea-tree oil and its major components on Staphylococcus aureus, Staph. epidermidis and Propionibacterium acnes.

Abstract

Major components of two tea-tree oil samples were identified using thin layer and gas-liquid chromatography (TLC and GLC). Using a TLC-bioautographic technique, the tea-tree oils, terpinen-4-ol, alpha-terpineol and alpha-pinene were found to be active against Staphylococcus aureus, Staph. epidermidis and Propionibacterium acnes whereas cineole was inactive against these organisms. The MIC values of the three active compounds increased in the order alpha-terpineol < terpinen-4-ol < alpha-pinene for all three micro-organisms. MIC values of the tea-tree oils and terpinen-4-ol were lower for P. acnes than for the two staphylococci. This study supports the use of tea-tree oil in the treatment of acne, and demonstrates that terpinen-4-ol is not the sole active constituent of the oil.

Inflammation

Br J Dermatol. 2002 Dec;147(6):1212-7.

Tea tree oil reduces histamine-induced skin inflammation.

Abstract

BACKGROUND:

Tea tree oil is the essential oil steam-distilled from Melaleuca alternifolia, an Australian native plant. In recent years it has become increasingly popular as an antimicrobial for the treatment of conditions such as tinea pedis and acne.

OBJECTIVES:

To investigate the anti-inflammatory properties of tea tree oil on histamine-induced weal and flare.

METHODS:

Twenty-seven volunteers were injected intradermally in each forearm (study and control assigned on an alternating basis) with histamine diphosphate (5 microg in 50 microL). Flare and weal diameters and double skin thickness were measured every 10 min for 1 h to calculate flare area and weal volume. At 20 min, 25 microL of 100% tea tree oil was applied topically to the study forearm of 21 volunteers. For six volunteers, 25 microL paraffin oil was applied instead of tea tree oil.

RESULTS:

Application of liquid paraffin had no significant effect on histamine-induced weal and flare. There was also no difference in mean flare area between control arms and those on which tea tree oil was applied. However, mean weal volume significantly decreased after tea tree oil application (10 min after tea tree oil application, P = 0.0004, Mann-Whitney U-test).

CONCLUSIONS:

This is the first study to show experimentally that tea tree oil can reduce histamine-induced skin inflammation.

Fungus

Australas J Dermatol. 1992;33(3):145-9.

Tea tree oil in the treatment of tinea pedis.

Abstract

Tea tree oil (an essential oil derived primarily from the Australian native Melaleuca alternifolia) has been used as a topical antiseptic agent since the early part of this century for a wide variety of skin infections; however, to date, the evidence for its efficacy in fungal infections is still largely anecdotal. One hundred and four patients completed a randomized, double-blind trial to evaluate the efficacy of 10% w/w tea tree oil cream compared with 1% tolnaftate and placebo creams in the treatment of tinea pedis. Significantly more tolnaftate-treated patients (85%) than tea tree oil (30%) and placebo-treated patients (21%) showed conversion to negative culture at the end of

therapy ($p < 0.001$); there was no statistically significant difference between tea tree oil and placebo groups. All three groups demonstrated improvement in clinical condition based on the four clinical parameters of scaling, inflammation, itching and burning. The tea tree oil group (24/37) and the tolnaftate group (19/33) showed significant improvement in clinical condition when compared to the placebo group (14/34; $p = 0.022$ and $p = 0.018$ respectively). Tea tree oil cream (10% w/w) appears to reduce the symptomatology of tinea pedis as effectively as tolnaftate 1% but is no more effective than placebo in achieving a mycological cure. This may be the basis for the popular use of tea tree oil in the treatment of tinea pedis.

Australas J Dermatol. 2002 Aug;43(3):175-8.

Treatment of interdigital tinea pedis with 25% and 50% tea tree oil solution: a randomized, placebo-controlled, blinded study.

Abstract

Tea tree oil has been shown to have activity against dermatophytes in vitro. We have conducted a randomized, controlled, double-blinded study to determine the efficacy and safety of 25% and 50% tea tree oil in the treatment of interdigital tinea pedis. One hundred and fifty-eight patients with tinea pedis clinically and microscopy suggestive of a dermatophyte infection were randomized to receive either placebo, 25% or 50% tea tree oil solution. Patients applied the solution twice daily to affected areas for 4 weeks and were reviewed after 2 and 4 weeks of treatment. There was a marked clinical response seen in 68% of the 50% tea tree oil group and 72% of the 25% tea tree oil group, compared to 39% in the placebo group. Mycological cure was assessed by culture of skin scrapings taken at baseline and after 4 weeks of treatment. The mycological cure rate was 64% in the 50% tea tree oil group, compared to 31% in the placebo group. Four (3.8%) patients applying tea tree oil developed moderate to severe dermatitis that improved quickly on stopping the study medication.

Nat Prod Res. 2017 Feb;31(4):460-464. doi: 10.1080/14786419.2016.1195379. Epub 2016 Jun 16.

Oxygenated monoterpenes-rich volatile oils as potential antifungal agents for dermatophytes.

Abstract

Essential oils (EOs) extracted from Lavandula luisieri and Cymbopogon citratus were tested for their antifungal activity against ten clinical isolates of dermatophytes isolated from cases of tinea pedis. Inhibition of conidial germination and antifungal drug/EO combination assay were tested on two ATCC reference strains of Trichophyton rubrum

and Trichophyton mentagrophytes. EOs were characterised by high amount of oxygenated monoterpenes in their composition. Strong antifungal activity was observed for the majority of clinical strains, and fungicidal activity was demonstrated. Positive interaction between L. luisieri EO combined with terbinafine was observed against terbinafine-resistant strain (Tr ATCC MYA-4438). Significative reduction of the germination was observed above 100 μg mL^{-1}. Both oils were safe to macrophage mammalian cells at tested concentration. This study describes the antifungal activity of L. luisieri and C. citratus EOs against dermatophytes, which could be useful in designing new formulations for topical treatments.

An Bras Dermatol. 2013 May-Jun;88(3):381-5. doi: 10.1590/abd1806-4841.20131800.

Treatment of pityriasis versicolor with topical application of essential oil of Cymbopogon citratus (DC) Stapf - therapeutic pilot study.

Abstract

BACKGROUND:

Pityriasis versicolor is a fungal infection caused by Malassezia spp. that has frequent relapses.

OBJECTIVES:

The main objective of this research was to perform phase I and II clinical studies, using formulations containing essential oil of Cymbopogon citratus in patients with pityriasis versicolor.

METHODS:

Phase I study included twenty volunteers to ascertain the safety of the formulations. In phase II, 47 volunteers randomly received essential oil formulations at 1.25 μL/mL concentration, for forty days. The shampoo should be applied three times a week and the cream twice a day. A control group in phase II, consisting of 29 volunteers, received the same formulations but with 2% ketoconazole as the active ingredient.

RESULTS:

No significant adverse events were observed in volunteers during Phase I. In Phase II, 30 (63.83%) volunteers using essential oil and 18 (62.07%) using ketoconazole remained until the end of the study. We observed a predominance of lesions in disseminated form, with M. sympodialis detected as the predominant agent identified in cultures. After 40 days of treatment, the rate of mycological cure was 60% ($p < 0.05$) for the group treated with essential oil of C. citratus and over 80% ($p < 0.05$) for the group treated with ketoconazole formulations.

CONCLUSIONS:

Notwithstanding the safety and antifungal effects observed in this study after application of formulations containing the essential oil of C. citratus, further studies with larger populations should be performed to confirm the actual potential of these formulations in

the treatment of patients with Pityriasis versicolor.

Mol Med Rep. 2012 May;5(5):1163-8. doi: 10.3892/mmr.2012.821. Epub 2012 Mar 5.
Antifungal properties of Japanese cedar essential oil from waste wood chips made from used sake barrels.

Abstract
In this study, we prepared essential oil (EO) from waste wood chips made from used sake barrels (USBs) of Japanese cedar (i.e., EO-USB) by steam distillation. We found that EO-USB and three commercially purchased EOs derived from xylem tissue of Japanese woods, such as Japanese cedar (Cryptomeria japonica), Japanese cypress (Chamaecyparis obtusa) and false arborvitae (Thujopsis dolabrata), suppressed fungal growth activity against Trichophyton rubrum, which is the cause of tinea disease. The magnitude of the suppressive effects of the EOs ranked as follows: T. dolabrata > USB = C. japonica > C. obtusa. These EOs also inhibited the activity of DNA polymerase in an extract from T. rubrum mycelia with the following ranking: T. dolabrata > USB = C. japonica > C. obtusa. In addition, 50 µg/ml of EO-USB showed antifungal properties, killing T. rubrum mycelia at 27-42˚C in 20 min. By gas chromatography/mass spectrometry analysis, the main sesquiterpenes in EO-USB were δ-cadinene (25.94%) and epi-cubenol (11.55%), and the composition of EO-USB was approximately the same as that of EO-C. japonica. Three prepared sesquiterpenes, δ-cadinene, epi-cubenol and β-eudesmol, inhibited the fungal growth and DNA polymerase activities of T. rubrum, and epi-cubenol showed the strongest inhibition among the compounds tested. These sesquiterpenes had no inhibitory effects on the activities of other DNA metabolic enzymes, such as DNA topoisomerase II, IMP dehydrogenase, polynucleotide kinase and deoxyribonuclease from T. rubrum. Taken together, these results suggest that EO-USB containing epi-cubenol may be useful for its anti-tinea disease properties, which are based on DNA polymerase inhibition.

J Agric Food Chem. 2005 Feb 9;53(3):614-9.
Chemical composition and antifungal activity of essential oils from different tissues of Japanese Cedar (Cryptomeria japonica).

Abstract
In this study antifungal activities of essential oils from different tissues of Japanese cedar (Cryptomeria japonica D. Don) against four wood decay fungi and six tree pathogenic fungi were investigated. In addition, the yields of essential oils obtained by water distillation were compared and their constituents determined by GC-MS analyses. The yield of essential oils from four tissues of Japanese cedar is in the decreasing order of leaf (27.38 mL/kg) > bark (6.31 mL/kg) > heartwood (3.80 mL/kg) > sapwood (1.27 mL/kg). Results obtained from the antifungal tests demonstrate that the essential oil of

Japanese cedar heartwood used against Laetiporus sulphureus and Trametes versicolor and sapwood essential oil used against L. sulphureus had strong antifungal activities at 500 mug/mL, with IC(50) values of 39, 91, and 94 microg/mL, respectively. Besides, the essential oils of Japanese cedar heartwood used against Rhizoctonia solani, Collectotrichum gloeosporioides, Fusarium solani, and Ganoderma australe had strong antifungal activities at 500 microg/mL, with IC(50) values of 65, 80, 80, and 110 microg/mL, respectively. GC-MS analyses showed that the sesquiterpene hydrocarbon compounds dominate in the essential oil from Japanese cedar heartwood, amounting to a total percentage of 82.56%, with the major compounds of delta-cadinene (18.60%), isoledene (12.41%), and gamma-muurolene (11.82%). It is proposed that the excellent antifungal activities of Japanese cedar heartwood essential oils might correlate with the presence of these compounds.

Nihon Ishinkin Gakkai Zasshi. 2007;48(1):27-36.

Combined effect of heat, essential oils and salt on fungicidal activity against Trichophyton mentagrophytes in a foot bath.

Abstract

This work was originally undertaken to determine the effective conditions of essential oils against Trichophyton mentagrophytes in vitro for the treatment of tinea pedis in a foot bath. Agar blocks implanted with T. mentagrophytes were immersed in 0.1% aqueous agar containing two-fold dilutions of essential oils with or without sodium chloride at 27 degrees C, 37 degrees C and 42 degrees C for 10 and 20 min. The number of surviving mycelia on the agar blocks was determined from the standard curves of the colony diameter and original inocula of the conidia. At the same time, the thermal effect on the cellular morphology was examined using SEM. Most fungal mycelia (99.7%) were killed after treatment at 42 degrees C for 20 min without essential oil. The fungicidal activity of essential oils was markedly enhanced by treating at 42 degrees C for 20 min as compared with that at 27 degrees C, showing 1/4 - 1/32-fold reduction of minimum fungicidal concentration (MFC to kill 99.99%). The order of the fungicidal activity of 11 essential oils was oregano, thyme thymol, cinnamon bark > lemongrass > clove, palmarose, peppermint, lavender > geranium Bourbon, tea tree > thyme geraniol oils. MFCs were further reduced to 1/2 - 1/8 by the addition of 10% sodium chloride. The salt effect was explained, at least partly, by an increase in mycelial adsorption of antifungal constituents in the presence of sodium chloride. Considerable hyphal damage was done at 27 degrees C by the essential oils, but no further alteration in morphology of the hyphae treated at 42 degrees C with or without oil was observed by SEM. The inhibitory effect of heat and oils was also observed against mycelia of T. rubrum and conidia of T. mentagrophytes. Thermotherapy combined with essential oils and salt would be promising to treat tinea pedis in a foot bath.

Mycoses. 2001 May;44(3-4):99-107.

In-vitro and in-vivo anti-Trichophyton activity of essential oils by vapour contact.

Abstract

The minimum inhibitory doses (MIDs) of essential oils by vapour contact to inhibit the growth of Trichophyton mentagrophytes and Trichophyton rubrum on agar medium were determined using airtight boxes. Among seven essential oils examined, cinnamon bark oil showed the least MID, followed by lemongrass, thyme and perilla oils. Lavender and tea tree oils showed moderate MID, and citron oil showed the highest MID, being 320 times higher than that of cinnamon bark oil. The MID values were less than the minimum inhibitory concentration (MIC) values determined by agar dilution assay. Furthermore, the minimum agar concentration (MAC) of essential oils absorbed from vapour was determined at the time of MID determination as the second antifungal measure. The MAC value by vapour contact was 1.4 to 4.7 times less than the MAC remaining in the agar at the time of MIC determination by agar dilution assay. Using selected essential oils, the anti-Trichophyton activity by vapour contact was examined in more detail. Lemongrass, thyme and perilla oils killed the conidia, inhibited germination and hyphal elongation at 1-4 micrograms ml-1 air, whereas lavender oil was effective at 40-160 micrograms ml-1 air. The in-vivo efficacy of thyme and perilla oils by vapour contact was shown against an experimental tinea pedis in guinea pigs infected with T. mentagrophytes. These results indicated potent anti-Trichophyton action of essential oils by vapour contact.

Fitoterapia. 2005 Mar;76(2):247-9.

Sensitivity of fungi isolated from onychomycosis to Eugenia cariophyllata essential oil and eugenol.

Abstract

The antifungal activity of Eugenia cariophyllata essential oil and eugenol, its major constituent, on fungal strains isolated from onychomycosis was evaluated. The natural products presented prominent antifungal action with MIC of 1% and 4%, respectively.

Mycoses. 2004 Apr;47(3-4):87-92.

Herbal medicines for treatment of fungal infections: a systematic review of controlled clinical trials.

Abstract

Traditional medicine has made use of many different plant extracts for treatment of fungal infections and some of these have been tested for in vitro antifungal activity. This systematic review evaluates antifungal herbal preparations that have been tested in controlled clinical trials. Four electronic databases were searched for controlled clinical

trials of antifungal herbal medicines. Data were extracted in a standardized manner by two independent reviewers and are reviewed narratively. Seven clinical trials met our inclusion criteria. Tea tree oil preparations were tested in four randomized clinical trials and some positive outcomes were attributed to the intervention in all trials. Solanum species (two trials) and oil of bitter orange preparations (one trial) were compared with conventional treatments. In all cases encouraging results were reported. There are few controlled clinical trials of herbal antifungal medicines. The most thoroughly clinically tested is tea tree oil, which holds some promise. All herbal remedies require further investigation in rigorous clinical trials.

Candida

Fitoterapia. 2007 Sep;78(6):396-400. Epub 2007 May 23.
Eugenol and thymol, alone or in combination, induce morphological alterations in the envelope of Candida albicans.
Abstract
The envelope of Candida albicans, with its outermost array of macromolecules protruding towards the environment, is pivotal to the expression of major virulence factors such as adhesiveness, and the morphological transition to hyphal form. We tested the anticandidal activity of eugenol, main component of clove oil, and thymol, main component of thyme oil, alone or in combination, by investigating their ability to interfere with the architecture of the envelope of C. albicans. Both molecules alterated the morphogenesis of the envelope, but the effects of thymol were more pronounced than those of eugenol. Certain combinations of the two molecules led to a synergistic effect, which is interesting in the view of potentiating their inhibition of C. albicans colonisation and infectiousness.

Contact Dermatitis From Essential Oils

Contact Dermatitis. 2014 Sep;71(3):129-37. doi: 10.1111/cod.12199. Epub 2014 Mar 20.
The optimal patch test concentration for ascaridole as a sensitizing component of tea tree oil.
Abstract
BACKGROUND:
Tea tree oil is used as a natural remedy, but is also a popular ingredient in household and cosmetic products. Oxidation of tea tree oil results in degradation products, such as ascaridole, which may cause allergic contact dermatitis.
OBJECTIVES:

To identify the optimal patch test concentration for ascaridole, and to investigate the relationship between a positive reaction to ascaridole and a positive reaction to oxidized tea tree oil.

PATIENTS/MATERIALS/METHODS:

Three hundred and nineteen patients with eczema were patch tested with ascaridole 1%, 2%, and 5%, and 250 patients were patch tested with oxidized tea tree oil 5%. Readings were performed on D3 and D7 according to a patch test calibration protocol.

RESULTS:

With an increasing ascaridole test concentration, the frequency of positive reactions increased: ascaridole 1%, 1.4%; ascaridole 2%, 5.5%; and ascaridole 5%, 7.2%. However, the frequencies of irritant and doubtful reactions also increased, especially for ascaridole 5%. A positive reaction to ascaridole was related to a positive reaction to tea tree oil.

CONCLUSIONS:

This study is in support of ascaridole being a sensitizer. We recommend patch testing with ascaridole at 2%. The finding that every positive reaction to oxidized tea tree oil is accompanied by a positive reaction to ascaridole suggests that ascaridole might be a contact allergen in oxidized tea tree oil.

Ann Dermatol Venereol. 2001 Feb;128(2):123-6.

[Allergic contact dermatitis to cosmetics containing Melaleuca alternifolia (tea tree oil)].

Abstract

INTRODUCTION:

Melaleuca alternifolia is a coniferous tree found in tropical regions, the needles contain an essential oil that is used in medical and cosmetic products. The essential oil contains turpentines (limonene, alpha-pinene, phellandrene) that are potentially allergenic.

PATIENTS AND METHODS:

In 1997, 1216 patients were patch tested in our dermatoligic unit. Fourteen of them tested because of eczema used products containing tea tree oil. The patients used creams, hair products and essential oils containing Melaleuca alternifolia for cosmetic reasons and to treat skin affections. They were patch tested for a standard panel of allergens, topical emulgators, perfumes, plants, topical medications, metal, gloves, topical disinfectants and preservatives, dental products and rubber derivatives. Products containing Melaleuca alternifolia were tested concentrated or diluted.

RESULTS:

We report on 7 cases of patients with an allergic contact dermatitis due to tea tree oil. Two of them also exhibited from a delayed type IV hypersensitivity towards fragrance-mix or colophony suggesting the possibility of cross reaction or an allergic

group reaction caused by contamination of the colophony with the volatile fraction of turpentines.

DISCUSSION:

The allergic potential of low concentrations of Melaleuca alternifolia is presumed to be low on healthy skin. Photoaged Melaleuca alternifolia must be considered to be a stronger sensitizer.

Am J Contact Dermat. 2000 Dec;11(4):238-42.

Allergic contact dermatitis to tea tree oil with erythema multiforme-like id reaction.

Abstract

The commercial production of tea tree oil, extracted from Melaleuca alternifolia Cheel, has considerably increased over the past 15 years in response to a strong demand for natural remedies and aromatic substances. The number of case reports that describe allergic contact dermatitis (ACD) to this essential oil is also on the rise. We report an additional case of ACD to tea tree oil that presented with an extensive erythema multiforme-like reaction. A skin biopsy was performed from a targetlike lesion distant from the site of the initial dermatitis. The patient was treated with systemic and topical corticosteroids. Five months later, he was patch tested to the North American standard series, to his own tea tree oil, to a fresh batch of tea tree oil, and to some related allergens. The skin biopsy showed a spongiotic dermatitis without histological features of erythema multiforme. Patch testing elicited a 3+ reaction to old, oxidized tea tree oil, a 2+ reaction to fresh tea tree oil, a 2+ reaction to colophony, a 1+ reaction to abitol, and a 1+ reaction to balsam of Peru. We believe this is the first report of erythema multiforme-like reaction secondary to ACD from tea tree oil. Other interesting features are the stronger reaction to oxidized than to fresh tea tree oil, and concomitant reactivity to colophony, abitol, and balsam of Peru.

Australas J Dermatol. 2007 May;48(2):83-7.

Allergy to tea tree oil: retrospective review of 41 cases with positive patch tests over 4.5 years.

Abstract

Tea tree oil use is increasing, with considerable interest in it being a 'natural' antimicrobial. It is found in many commercially available skin and hair care products in Australia. We retrospectively reviewed our patch test data at the Skin and Cancer Foundation Victoria over a 4.5-year period and identified 41 cases of positive reactions to oxidized tea tree oil of 2320 people patch-tested, giving a prevalence of 1.8%. The tea tree oil reaction was deemed relevant to the presenting dermatitis in 17 of 41 (41%) patients. Of those with positive reactions, 27 of 41 (66%) recalled prior use of tea tree

oil and eight of 41 (20%) specified prior application of neat (100%) tea tree oil. Tea tree oil allergic contact dermatitis is under-reported in the literature but is sufficiently common in Australia to warrant inclusion of tea tree oil, at a concentration of 10% in petrolatum, in standard patch-test series. Given tea tree oil from freshly opened tea tree oil products elicits no or weak reactions, oxidized tea tree oil should be used for patch testing.

Australas J Dermatol. 2002 Aug;43(3):211-3.
Allergic contact dermatitis following exposure to essential oils.
Abstract
Allergic contact dermatitis from the topical use of essential oils is not widely recognized as an occupational hazard. Four cases of allergic contact dermatitis to essential oils occurring in three aromatherapists and one chemist with a particular interest in aromatherapy are described. All presented with predominantly hand dermatitis and demonstrated sensitization to multiple essential oils. One patient developed a recurrence of cutaneous symptoms following ingestion of lemongrass tea. Workers within this industry should be aware of the sensitization potential of these products and the risk of limiting their ability to continue employment.

Clin Exp Dermatol. 1995 Mar;20(2):143-5.
Allergic airborne contact dermatitis from essential oils used in aromatherapy.
Abstract
Contact allergy to various essential oils used in aromatherapy was demonstrated on patch testing in a 53-year-old patient suffering from relapsing eczema resistant to therapy on various uncovered parts of the skin, in particular the scalp, neck and hands. Sensitization was due to previous exposure to lavender, jasmine and rosewood. Laurel, eucalyptus and pomerance also produced positive tests, although there was no hint of previous exposure. A diagnosis of allergic airborne contact dermatitis was thus established. On topical and systemic glucocorticoid treatment (peroral methylprednisolone at an initial dose of 60 mg/day) the skin lesions eventually resolved. Due to persistence of the volatile essential oils in the patient's home after a year-long use of aroma lamps, complete renewal of the interior of the patient's flat was considered essential. Due to changing self-medication habits, with increasing orientation to 'natural' modes of treatment, increasing numbers of such sensitizations might be on the horizon.