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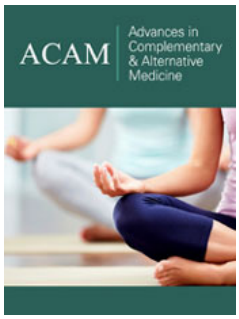
Research Article

Anti-Fungal Properties of Tea Tree Oil, Oregano Oil, Lavender Oil, Coconut Oil for Nails, and a Survey of Pharmacy Students' Views

ISSN: 2637-7802



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Abstract

Nail fungus, also known as onychomycosis, involves infection of the nails typically toenails by various types of fungi. The impact of nail fungal infection includes pain and discomfort, cosmetic concerns, risk of spreading, treatment challenges, functional impairment, and medical complications. This report reviews the potential use and effectiveness of tee tree oil, oregano oil, lavender oil, and coconut oil in treating these infections. A survey was conducted during a Drug Informatics class as a homework assignment to P1 (first-year) pharmacy students. The purpose of the survey was to determine the participants' levels of knowledge and to measure their opinions based on literature review. The survey contained five knowledge-based questions and five opinion-based questions. A total of 39 students participated in this study. The knowledge-based questions showed that a-72.6% correct answer rate. The question that received the highest percentage of correct answers (94%) was the answers regarding tea tree oil. The opinion-based questions showed that respondents had a positive view regarding the use of oils in the treatment of nail fungus infections. The cumulative agreement rate (agree and strongly agree) was 86.6%.

Keywords: Onychomycosis; Dermatophytes; Environment; Antiseptic

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Submission: February 01, 2024
Published: February 22, 2024

Volume 7 - Issue 5

How to cite this article: Aaren Berkley, Bisrat Hailemeskel* and Fekadu Fullas. Anti-Fungal Properties of Tea Tree Oil, Oregano Oil, Lavender Oil, Coconut Oil for Nails, and a Survey of Pharmacy Students' Views. Adv Complement Alt Med. 7(5). ACAM. 000680. 2024.
DOI: 10.31031/ACAM.2024.07.000680

Introduction

Nail fungus, or onychomycosis, arises from fungal infections affecting toenails. The fungi, commonly dermatophytes, yeasts, or molds, enter through cracks or injuries, thriving in warm, moist environments. The resulting impact encompasses pain, cosmetic issues, spreading risks, and potential complications, affecting the quality of life for those affected. Beyond physical discomfort, infected nails can lead to self-esteem issues and embarrassment. This study focuses on four herbal remedies-Tea Tree Oil, Oregano Oil, Lavender Oil, and Coconut Oil-as potential solutions to address these challenges. Onychomycosis accounts for about 90% of toenail infections worldwide and manifests as discoloration of the nail, local pain, and paresthesia. It also may involve the adjacent skin. In addition, the infection has social implications on social interactions [1]. Onychomycosis caused by dermatophytes such as *Trichophytum rubrum* and nondermatophytes and molds is an infection of the nails. The infection can lead to the formation of thick nail plates. It is also difficult to treat because of the thick plate barrier, a high re-infection rate, biofilm formation and low efficacy of most antifungal agents. When there are contraindications to available oral antifungal agents, patients to lower risk and accessible alternative therapies. Home remedies, such as plant-derived oils are one such alternative [2].

Disease mechanism

Onychomycosis can infect both fingernails and toenails, but it appears that toenail infection is much more prevalent. Hotel carpets, public showers, and pool decks are common sources of nail infection. The presence of warm moisture in shoes and micro-traumatic pressure on the nail provide a conducive environment for the dermatophyte to penetrate the nail bed [3].

Prevalence and impact

Prevalence estimates range from 1% to 8%, and the incidence is increasing [3]. The estimated prevalence of onychomycosis in North America is up to 13.8% for adults and 0.44% for children and adolescents younger than 18 years [4]. Onychomycosis is a fungal infection of the fingernails or toenails that causes discoloration, thickening, and separation from the nail bed. Onychomycosis occurs in 10% of the general population but is more common in older adults; the prevalence is 20% in those older than 60 years and 50% in those older than 70 years. The increased prevalence in older adults is related to peripheral vascular disease, immunologic disorders, and Diabetes Mellitus. The risk of onychomycosis is 1.9 to 2.8 times higher in persons with diabetes compared with the general population. In patients with human immunodeficiency virus infection, the prevalence ranges from 15% to 40% [5].

A Review of Oil Home Remedies

Tea tree oil

Tea Tree Oil comes from steam distillation of the leaves of a tea tree also known as the melaleuca alternifolia plant are commonly found in Australia. It is a natural remedy commonly used to treat nail fungus at home. This oil is believed to have antifungal and antiseptic properties which help manage fungal infection [6]. A few clinical studies on the merits of tea tree oil in the treatment of fungal nail infections have been reported.

In clinical trials, mycological cure rates for onychomycosis treated with tea tree oil twice daily for 6 months were reported to be between 82 and 89%, and a lesser clinical cure rate of 27 to 78.5% [7-9]. A double-blind, randomized, controlled study of 117 patients compared twice daily 100% tea tree oil versus twice daily 1% clotrimazole solution for 6 months [9]. Mycological and clinical cure rates were comparable between the two groups. A double-blind, randomized, controlled study of 60 patients compared an 8-week treatment course of combined 5% tea tree oil and 2% butenafine hydrochloride cream versus tea tree oil cream alone. About 80% of patients treated with the 5% tea tree oil/2% butenafine hydrochloride achieved a complete cure, while no patient receiving tea tree oil alone achieved a complete cure at the end of the 8-week treatment [10].

Oregano oil

Oregano Oil contains thymol which is a plant-based derivative with antifungal and antiseptic properties as well. It is another natural oil that is used at home when battling nail infections. In an open-label, single-arm clinical trial Alessandrini et al. [8] demonstrated the usefulness of a topical antifungal preparation containing vitamin E and essential oils of lime, oregano, and tea tree. There were 20 patients who participated in this study over a course of six months. A 78.5% clinical cure rate was observed, with 14.3% showing only partial cure. About 7% did not show clinical response. The results indicated that combination treatment is an effective and safe topical therapy of the nail and could be used as a first line treatment. It was found that the topical formulation is well-absorbed into the nail plate resulting in the nail being more resistant to future fungi and can prevent relapses of infections. The clinical appearance of the nail showed improvement within the first week of treatment. However, in this trial oregano oil was only one of the constituents and it is not clear whether oregano oil by itself is effective [8].

Lavender oil

Lavender Oil is known for its pleasant aroma and its antimicrobial properties. Lavender oil is extracted from lavender flowers. It is believed that due to its antimicrobial properties, it is beneficial in fighting fungus infections of the nail. The Society for General Microbiology reported on the use of lavender oil in the treatment of nail fungus infections. Scientists from the University of Columbia tested the oil against a range of pathogenetic fungi including nail fungi, athletes' foot, and infections of the scalp. The study found that lavender oil is effective in treating nail fungus and is effective against resistant anti-fungal infections. The essential oil is a very potent anti-fungal product which is very effective [11].

Coconut oil

Coconut Oil is obtained from coconut trees in subtropical regions in the world. Due to its fatty acid constituents, coconut oil is used as a natural remedy for nail fungus. The fatty acids can break down the fungal membrane by inserting in the lipid layer [12]. A study conducted in 2007 on the effect of antimicrobial properties of coconut oil on yeast infections in the nails showed a positive outcome [13]. Fifty-two spices of yeast species were collected and sent to a medical laboratory, and coconut oil was tested against the fungus species to determine whether it was an effective treatment for fungal infections. Coconut oil was found to be active against the test species of fungi. The study recommended coconut oil for the treatment of fungal infections and against drug-resistant species of yeast.

Healthcare Professionals' Knowledge & Opinions

The use of essential oils such as tea tree oil, lavender oil, coconut oil, and oregano oil for treating nail fungi varies from one healthcare provider to the other. Due to inadequate research involving essential oils and nail fungi, there are no case studies directly linking the two. Surveys are lacking on the opinions of healthcare providers about the use of aromatherapy and essential oils in treatment of various diseases and infections. The use of aromatherapy and alternative medication therapy that can be beneficial to inpatients and outpatients was reported [14]. Healthcare providers' opinions on the use of essential oils for treatment were that aromatherapy can be very beneficial for symptom management with infections as seen with the essential oils such as tea tree oil, lavender oil, oregano oil, and coconut oil. However, aromatic essential oils can be dangerous as they can be highly flammable, cause skin irritations and burns, oral toxicity, and if used in dangerous amounts or not used cautiously [14].

Literature Gap, Study Objective, and Impact

Due to the lack of or limited number of clinical trials, there is a gap of knowledge on the evidence on the effectiveness of herbal

remedies for nail fungus infections. The quality and potency of herbal products can vary significantly, making it difficult to compare results from various studies. Studies on herbal remedies for nail fungus infections focus more on cosmetic improvements rather than completely curing the infection,

Studies need to be undertaken with an objective, focusing on testing herbal remedies for nail fungus infections, evaluating efficiency, safety, tolerability, quality, standardization of oils, patient perspectives, and comparative studies. In this respect, if highly structured and designed studies are conducted to address the literature gaps, and fulfil the study objectives, the potential impact could result in clearer clinical guidelines, thus allowing patients to have more information and choices regarding treatment.

Methods

This survey was conducted during a Drug Informatics course given to first year (P1) pharmacy students. During the course, students received instructions and guidance on research methods and how to create and conduct surveys. Each student was assigned a different research topic and was tasked to develop two sets of questions for the survey. Each set of questions contained five questions. The students were asked to develop five knowledge based true or false questions based on their topic. The second set of five questions were opinion based. The questions were incorporated into an online survey that was sent out as a homework assignment, and all students in the class were asked to participate. The identities of those who answered the survey were kept anonymous. The responses from participants were collected and put into charts and graphs and released back, so the results could be reviewed. Descriptive statistics were used to calculate mean and variance values. A 4-point Likert scoring was used to measure responses to opinion-based questions: 4 for strongly agree; 3 for agree; 2 for disagree; and 1 for strongly disagree opinions. This paper examines one of the topics that were covered in the course.

Results

Demographics

Demographic data, such as gender, age, and states the respondents lived in before coming to Howard's Pharmacy Program are shown in Table 1. Out of a class of 40 participants, 39 completed the survey, representing a-98% response rate for this section. Ten (25.6%) were male, and 29 (74.4%) were female. The majority (n =20, 51.3%) were in the 18-24 age range, while 15 (38.5%) were between 24 and 30 years. A small number (n=3, 7.7%) fell in the group 30-40 years of age. Only one participant was over 40 years.

Table 1: Demographic characteristics of participants (n=39).

		n (%)
Gender	Male	10 (25.6)
	Female	29 (74.4)
Age (years)	18-24	20 (51.3)
	24-30	15 (38.5)
	30-40	3 (7.7)
	Above 40	1 (2.6)
State you lived in before coming to Howard Pharmacy Program. *	Washington DC	6 (15.8)
	Maryland	15 (39.5)
	Virginia	1 (2.6)
	Other States	16 (42.1)

Participants work and educational background

Table 2 shows the educational backgrounds and work history of the respondents prior to joining Howard University Pharmacy program. Among the 39 respondents, two (5.1%) had never worked. Twelve students (30.8%) worked for one to two years. Nine students (23.1%) worked for three to four years. About 41% (n=16) had worked for five years or more, before joining the program. Regarding the type of work, only 37 out of the 39 participants responded. 54.1% (n=20) worked in pharmacy related field. Nine (24.3%) worked in non-pharmacy areas. Eight (21.6%) worked in non-health related fields. Among the 39 respondents, four (10.3%) had a pre-pharmacy or some college level education. Two (5.1%) had an associate degree. Twenty-six participants (66.7%) had a BSc or BA degree educational level. Seven respondents (17.9%) had an educational level of MSc degree. No participant had a PhD or doctoral degree.

Table 2: Work and educational background of the participants.

Questions	Responses	n (%)
How many years have you had a paying job before joining the Pharmacy program at Howard?	Never worked	2 (5.1)
	1-2 years	12 (30.8)
	3-4 years	9 (23.1)
	5 or more	16 (41.0)

What kind of work have had?	Pharmacy Related work	20 (54.1)
	Non-Pharmacy but other health related work	9 (24.3)
	Non-Health Related	8 (21.6)
What is the highest educational level you have achieved before joining the pharmacy program at Howard?	Pre-Pharmacy or some college work	4 (10.3)
	Associate degree	2 (5.1)
	BSc or BA	26 (66.7)
	MSc	7 (17.9)
	PhD or Doctoral Degree	0 (0.0)

Knowledge- Based Questions

Table 3 represents the five true-false knowledge-based questions related to various herbal oils used to treat nail fungus. Overall, on average 72.6% of respondents answered the questions correctly. Approximately 27.4% of responders responded incorrectly. The question that was answered correctly the most with a 94.3% was regarding the many benefits of tea tree oil for its many benefits and antifungal properties and that it can be an effective natural remedy for nail fungus. The question that was answered incorrectly the most with the lowest correct percentage of 45.7% was the one related to the benefits of using oils instead of going to doctors for consultation. The question that received the next high correct percentage rate of 85.7% was for lavender as one of the most universal oils in the world that is used for various purposes, and that it may cause skin irritation when used undiluted. The question related to oregano oil received 68.6% correct answer rate. In computing the data in Table 3, each correct answer was scored 1, while the wrong answer was scored 0. The average standard deviation of about 0.41 relative to a mean of about 0.73.

Table 3: The results of the knowledge-based answers of respondents (n=35).

Question	Correct Answer	Participants with the Correct Answers (n,%)	Mean±SD	Variance
1. Tea tree oil is known for its many benefits and its antifungal properties. Tea tree oil can be an effective natural remedy for nail fungus.	True	33 (94.3)	0.9429±0.2355	0.0555
2. Oregano oils have antioxidant, antifungal, and anti-inflammatory properties. Consistent and long-term application of oregano oil is necessary to see improvement in nail fungus.	True	24 (68.6)	0.6857±0.4710	0.2218
3. Lavender is one of the most universal oils in the world, used for various purposes. However, lavender oil may cause skin irritation when used undiluted.	True	30 (85.7)	0.8571±0.3550	0.12601
4. Organic, raw coconut oil has a very high concentration of lauric acid and medium-chain fatty acids. These properties allow for coconut oil to be highly effective when combined with another antifungal.	True	24 (68.6)	0.6857±0.471	0.2218
5. Due to the accessibility and easy access of herbal remedies; using herbal oils instead of going to the doctor for a consult/medication is beneficial.	False	16 (45.7)	0.4571±0.5054	0.2555
Average correct response rate:		72.60%	0.7257±0.4076	0.1761

Opinion-Based Questions

Table 4 depicts data from five opinion-based questions. Overall, 86.6% of respondents on average strongly agreed or agreed with the potential of herbal oils such as tee tree oil, lavender oil, oregano oil, and coconut oil to be used for treating or helping treat nail fungus infections. The oil that had the highest total cumulative percentage of 84.8% strongly agree and agree opinion was for tea tree oil. Lavender oil had a 57.1% for strongly agree and 34.3% agree for a total of 91.4% agreement rate. On the other hand, on average of a cumulative 13.4% of the respondents strongly disagreed or disagreed with the questions discussing the potential benefits of herbal oils such as tea tree oil, lavender oil, oregano oil, and coconut oil being able to treat nail fungi. Oregano and coconut oils had the highest total disagreement percentage rates at 17.6% and 14.7%, respectively. The overall mean Likert score of the respondents at 3.2159 leans towards the scores of 3 and 4, which are a priori assigned to agree and strongly agree scoring.

Table 4: Opinion-Based Questions* Total respondents (n) for questions: 35 for 1&3; 34 for 2&4; and 33 for 5.

Question	Strongly Agree (n, %)	Agree (n, %)	Disagree (n, %)	Strongly Disagree (n, %)	Mean Likert Score ±S.D.	Variance
1. I agree that tea tree oil is an effective natural oil because it comes from the leaves of the Melaleuca alternifolia plant and has the potential to combat and remedy nail fungus infections	15 (42.9)	15 (42.9)	4 (11.4)	1 (2.9)	3.2571±0.7800	0.6084

2. I believe that oregano oil is beneficial in helping those who struggle with nail fungus due to the various properties of oregano oils such as the antioxidant, anti-fungal, and anti-inflammatory properties.	13 (38.2)	15 (44.1)	5 (14.7)	1 (2.9)	3.1765 ±0.7966	0.6346
3. I think due to the universal use of lavender oil, it is helpful in helping battle nail fungus but should be used with other antifungal medications (with an ok from a doctor or pharmacist) and used with caution to avoid irritation to battle nail fungi.	12 (34.3)	20 (57.1)	2 (5.7)	1 (2.9)	3.2286 ±0.6897	0.4756
4. I believe that due to the high concentration of lauric acid and medium-chain fatty acids, coconut oil is very effective in treating nail fungal infections and issues.	13 (38.2)	16 (47.1)	5 (14.7)	0 (0.0)	3.2353 ±0.6989	0.4884
5. I agree that herbal remedies are beneficial and effective in the treatment of nail fungi if used carefully and correctly by a patient.	11 (33.3)	18 (54.6)	3 (9.1)	1 (3.0)	2.1818±0.7269	0.5284
Average:	37.40%	49.20%	11.10%	2.30%	3.2159±7384	0.5471

Discussion

For the knowledge-based questions an average correct answer rate of 72.6% is indicative of a fair knowledge level of the survey participants. The highest correct answer at 94% was recorded for tea tree oil followed by 85.7% for lavender oil (Table 3). The overall knowledge level is higher than those previously reported for other natural products [15-17]. Leveraging on the information given in the review of oil home remedies section, a description of and explanation of the knowledge-based questions are provided.

1. Tea tree oil is known for its many benefits and its antifungal properties. It can be an effective natural remedy for nail fungus. This statement is true as tee tree oil has antifungal, antibacterial, and antiseptic properties, making it a popular choice of treatment for nail fungi and infections.

2. Oregano oils have antioxidant, antifungal, and anti-inflammatory properties. Consistent and long-term application of oregano oil is necessary to see improvement in nail fungus infection. This statement is true as oregano oil contains compounds such as carvacrol and thymol which exhibit antimicrobial and antifungal effects. For these effects to work and results to be noticed, the oil must be applied for 4-6 weeks.

3. Lavender is one of the most common universal oils in the world used for various purposes. However, lavender oil may cause skin irritation when used undiluted. The assertion is true as lavender oil is used for a wide range of purposes including aromatherapy, skincare, and antifungal treatment. The oil is very strong, so it needs to be diluted before use.

4. Organic, raw coconut oil has a very high concentration of lauric acid and medium-chain fatty acids. These properties allow coconut oil to be highly effective when combined with other antifungals. The statement is true as organic raw coconut oil contains high concentrations of lauric acid and medium-chain fatty acids, making it an effective antifungal, especially when used in combination with other treatments.

5. Due to the accessibility and easy access of herbal remedies, using herbal oils instead of going to the doctor for a consult/medication is beneficial. Of the five statements in the questionnaire, this is only one which is false, because herbal remedies are not a one-size-fits-all solution as there are different types of fungal infections which may need stronger or combination of medications rather than herbal oils alone. Different and more complicated infections should be investigated and addressed by a doctor or pharmacist.

For opinion-based questions, the overall mean Likert score of the respondents at 3.2159 is consistent with a general agreement rate and is reflected in a high 86.6% rate as shown in Table 4. Disagreement rate to opinion statements is minimal across all survey participants.

Conclusion

An online survey was conducted in a drug informatics class for P1 (first year) pharmacy students at Howard University. Out of a class size of 40 students, 35 to 39 participated in the survey for an average response rate of about 93%. The survey measured the knowledge and opinions of the participants on tea tree oil, oregano oil, lavender oil, and coconut oil for the treatment of nail fungal infection. The survey instrument comprised of five knowledge-based and five opinion-based questions. The respondents had a 72.6% correct level of knowledge, and a great majority of respondents (86.6%) had a positive attitude on the use of the four oils for the treatment of nail infections. The limitations of study include the small size of respondents; creating a setting which allowed participants to look up the internet to answer questions and form opinions; and selection bias, as this sample size was not randomly selected from a general population. The selection of participants was also limited to one class in a pharmacy program. The study did not consider factors such as cultural beliefs and marketing strategies of producers of essential/herbal oils, which could potentially influence answers and opinions on the topic.

Acknowledgement

All first-year pharmacy students at Howard University College of pharmacy who participated in this survey are acknowledged.

Statement of Informed Consent

Informed consent was not required from the survey participants, because it was part of a Drug Informatics course given by one of the authors, BH.

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