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EXPLORING ANTIFUNGAL POTENTIAL OF ESSENTIAL COMPOUNDS IN FISH OILS FOR TREATING SKIN INFECTIONS

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ABSTRACT: Skin fungal infections are a significant global public health concern due to growing resistance to traditional antifungal treatments. This study explores the fungicidal properties of key components in fish oils and their potential use in treating cutaneous fungal diseases. Fish oils contain bioactive substances like omega-3 fatty acids (EPA and DHA), vitamins, sterols, and antioxidants, which can combat fungal diseases by compromising cell membrane integrity, inhibiting fungal enzymes, influencing host immune responses, and interfering with fungal signaling pathways. Studies have shown that fish oil-derived chemicals are effective against fungal species linked to skin diseases, such as Candida spp., Malassezia spp., and dermatophytes. Preclinical investigations have shown that fish oil-derived molecules have medicinal potential. Topical formulations containing fish oil extracts have been shown to relieve fungal skin infections symptoms, facilitate healing, and have minimal negative effects. Combining fish oil with other natural antifungal substances, such as essential oils, plant extracts, and antimicrobial peptides, could create innovative treatment tactics for stubborn fungal infections, especially those produced by strains resistant to multiple drugs.

INTRODUCTION: Fungal infections of the skin, characterized by symptoms like erythema, pruritus, and desquamation, are caused by various fungus species that can invade various skin areas, including feet, nails, groin, and scalp [1]. Fungal infections are generally non-severe and can be treated with antifungal drugs. However, some cases may require more intensive therapy. It's crucial to consult a medical professional if you suspect a fungal infection to prevent its spread or potential complications [2].

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The discovery of effective antifungal therapies is crucial for treating fungal infections effectively and preventing their spread to other body regions, as inadequate treatment can lead to long-lasting pain, skin damage, and further infections [3]. Healthcare experts are crucial for selecting the right antifungal medicine for a specific case, as it is essential for managing and resolving the infection.

Adhering to the recommended treatment regimen and maintaining proper hygiene practices can prevent future fungal infections [4]. Consuming essential fish oils can boost your immune system and improve skin health, reducing the risk of fungal infections [5]. These oils are rich in omega-3 fatty acids, which have anti-inflammatory properties and may aid in combating infections [6]. Consuming essential fish oils like salmon, mackerel, or flaxseed regularly can improve your body's ability

to combat fungal growth and maintain healthy skin [7]. Small dietary and lifestyle changes can significantly reduce the risk and control of fungal infections **Table 1.**

Omega-3 Fatty Acids: The list of common omega-3 fatty acids in nature is provided below.

The Various Benefits of Omega-3 Fatty Acids: Omega-3 fatty acids are crucial for human health, providing numerous health benefits for the body and brain. Omega-3 fatty acids are beneficial for various health conditions, including depression, anxiety, eye health, brain health during pregnancy, heart disease risk, metabolic syndrome symptoms, inflammation, autoimmune diseases, mental disorders, age-related decline, Alzheimer's disease, asthma, and liver fat reduction.

TABLE 1: THE COMMON NAME AND CHEMICAL NAME OF OMEGA-3 FATTY ACIDS

Common name	Chemical name	Lipid name
α-Linolenic acid (ALA)	all-cis-9,12,15-octadecatrienoic acid	18:3 (n-3)
Hexadecatrienoic acid (HTA)	all-cis-7,10,13-hexadecatrienoic acid	16:3 (n-3)
Eicosatrienoic acid (ETE)	all-cis-11,14,17-eicosatrienoic acid	20:3 (n-3)
Stearidonic acid (SDA)	all-cis-6,9,12,15-octadecatetraenoic acid	18:4 (n-3)
Eicosapentaenoic acid (EPA)	all-cis-5,8,11,14,17-eicosapentaenoic acid	20:5 (n-3)
Eicosatetraenoic acid (ETA)	all-cis-8,11,14,17-eicosatetraenoic acid	20:4 (n-3)
Docosahexaenoic acid (DHA)	all-cis-4,7,10,13,16,19-docosahexaenoic acid	22:6 (n-3)
Docosapentaenoic acid (DPA), Clupanodonic acid	all-cis-7,10,13,16,19-docosapentaenoic acid	22:5 (n-3)
Tetracosahexaenoic acid (Nisinic acid)	all-cis-6,9,12,15,18,21-tetracosahexaenoic acid	24:6 (n-3)
Tetracosapentaenoic acid	all-cis-9,12,15,18,21-tetracosapentaenoic acid	24:5 (n-3)

Antifungal Properties of Essential Fish Oils: Essential fish oils possess anti-inflammatory and antifungal properties, effectively preventing skin fungus proliferation. They create an inhospitable environment on the skin, reducing the likelihood of infections [8]. Integrating these oils into your diet can improve skin health and strengthen your body's resistance against fungal infections. These simple dietary changes can significantly impact skin health and reduce the likelihood of future fungal issues [9]. Omega-3 fatty acids, found in essential fish oils, have antifungal properties, potentially aiding in treating skin diseases caused by fungus by reducing inflammation and strengthening the skin's barrier [10]. Essential oils can be used in topical treatments to enhance skin health and prevent fungal infections, in addition to consuming those [11]. Maintaining a balanced diet rich in essential oils and minerals is essential for promoting healthy skin and preventing fungal issues.

Research has shown that omega-3 fatty acids, a type of fish oil, possess anti-inflammatory properties that can help fight fungal infections [12]. Fish oil, rich in omega-3 fatty acids EPA and DHA, has been proven to reduce inflammation and promote skin health [13]. Fish oil pills or fatty fish like salmon, mackerel, or sardines are essential for maintaining a strong skin barrier and preventing fungal issues [14]. Essential oils like tea tree, lavender, and oregano have been proven to possess antifungal properties, aiding in the prevention of skin infections when applied topically [15]. Incorporate these oils into your dietary and skincare routine to maintain healthy, fungus-free skin. Essential fish oils and essential oils can offer a more natural and holistic approach to skincare compared to conventional antifungal therapies [16]. Conventional therapies may offer positive results but may have side effects or abrasive substances that cause skin irritation. Natural therapies like fish oils and essential oils can effectively nourish and protect skin without any concerns [17]. Consult a healthcare professional before incorporating essential oils into your routine to ensure their safety and suitability for your specific needs.

Mechanisms of Action: Fish oils, rich in omega-3 fatty acids, have been found to have anti-inflammatory properties and promote skin regeneration, making them an excellent option for treating irritated or inflamed skin [9, 18]. Essential oils offer potent antibacterial properties, effectively treating fungal infections without the harmful side effects of conventional antifungal drugs [19]. Understanding the mechanisms of natural treatments allows for informed decisions on their inclusion in your skincare regimen for improved skin health and happiness. Essential oils, containing terpenes, phenols, and aldehydes, have been found

to disrupt fungus cell membranes, leading to their eradication [20]. Chemicals can disrupt fungus' cell walls, leading to cell death. Essential oils offer a natural, effective alternative to conventional antifungal drugs, directly addressing the root cause of fungal infections, providing a natural solution [21]. The incorporation of essential oils into your skincare routine can effectively prevent fungal infections and improve the overall health of your skin.

Essential oils possess unique compounds with potent antifungal properties, effectively damaging fungi's cell membranes, inhibiting their growth and dissemination [22]. Integrating essential oils into your skincare routine can effectively address fungal infections and prevent future ones. This natural method has a milder effect on the skin and body compared to conventional antifungal drugs, making it a preferred holistic skincare approach. Recent studies reveal that essential oils can selectively target specific pathways within fungal cells, leading to their eradication, providing crucial insights into their effectiveness in combating fungus [23]. Understanding the molecular mechanisms of essential oils can help scientists develop more effective and precise remedies for fungal infections [24]. The study validates the use of essential oils in skincare, enabling the creation of new products that utilize nature's natural properties to improve skin health and beauty [25].

Mode of Action: Omega-3 fatty acids play a crucial role in anti-inflammatory effects, with increased levels of EPA or DHA reducing levels of PGE2 and 4 series-LT. These fatty acids compete with arachidonic acid in cell membranes, producing 3-series prostaglandins, thromboxanes, and 5-series leukotrienes with low pro-inflammatory potential.

The higher concentration of omega-3 fatty acids compared to arachidonic acid alters leukotriene biosynthesis, leading to anti-inflammatory effects. EPA and DHA also produce resolvins and related lipid signaling molecules, inhibiting neutrophil migration and TNF and IL-1β production. They also decrease adhesion molecule expression on leukocytes and endothelial cells and intercellular adhesive interactions. EPA and DHA are natural ligands for peroxisome proliferator-activated receptor (PPAR) gamma, which regulates inflammatory gene expression and NFκB activation. They also reduce triglyceride levels by inhibiting acyl-CoA: 1, 2-diacylglycerol acyltransferase, increasing mitochondrial and peroxisomal-beta-oxidation, decreasing lipogenesis, and increasing plasma lipoprotein lipase activity [26].

Application in Skin Fungal Infections: Researchers have discovered that essential oils like tea tree and lavender oil have antifungal properties, which can effectively treat common skin diseases like athlete's foot and ringworm, according to research **Fig. 1**. These oils have been found to be effective in treating cutaneous fungal infections [27]. The incorporation of these oils into various products, including topical applications, cosmetics, and herbal medicines, may provide consumers with potential benefits [28]. Essential oils in cosmetics are being used as an organic substitute for conventional therapies for fungal infections. Clinical trials have shown promising results, with tea tree, lavender, and oregano oils showing fungicidal capabilities, making them a promising alternative to conventional therapies [21]. Essential oils have been found to effectively suppress fungus responsible for skin diseases, making them a viable option for natural remedies. Further research indicates that essential oils can significantly improve our skincare approach for fungal infections [29]. Blending essential oils with carrier oils like coconut or almond oil is a safe and effective method for topically administering them for skin use [30].

Integrating essential oils into creams or lotions can ensure equitable distribution among affected regions and provide a more accessible and easily applied alternative for those seeking antifungal properties [31]. Integrating essential oils into skincare regimens offers therapeutic benefits and maintains skin health and vitality through various techniques. To ensure safety and avoid adverse effects; it's advisable to conduct a patch test before applying essential fish oils to the skin to detect potential irritation or allergic reactions, as some oils may trigger such reactions in certain individuals [32]. To safely use essential oils as a natural treatment for skin fungal infections, dilute them properly before application. Seeking guidance from a healthcare practitioner or certified aroma therapist can help identify the most suitable oil and application

technique for individual needs. By following these guidelines, individuals can effectively utilize essential oils without compromising their skin's health and safety.

FIG. 1: FUNGAL INFECTIONS OF THE HUMAN SKIN

Future Directions and Implications: Further investigation in the realm of aromatherapy and essential oils might center on the identification of distinct compounds present in essential oils that possess antifungal characteristics, as well as the elucidation of their mechanisms of action [20]. This has the potential to result in the creation of more precise and efficient combinations of essential oils for the treatment of skin fungal diseases. Furthermore, investigating the possible synergistic impacts of blending several essential oils might provide fresh perspectives on enhancing their medicinal advantages [33]. In summary, more investigation in this field has the capacity to improve the effectiveness and safety of using essential oils as a natural treatment for skin fungal infections. Presently, there are still knowledge gaps regarding the precise methods by which essential oils function on skin fungal infections, impeding the advancement of specific remedies. Moreover, there is a scarcity of study on the synergistic effects of blending several essential oils, resulting in unexplored advantages [34]. By doing more study to overcome these limitations, it is possible to significantly enhance the effectiveness and safety of essential oils as a natural treatment for skin fungal infections.

By performing studies that examine the individual compounds present in essential oils and their role in inhibiting the growth of fungus, researchers may enhance their comprehension of the molecular interactions between these chemicals and fungi [35]. In addition, investigating the possible synergistic effects of blending several essential oils might result in the creation of more powerful and efficient remedies for skin fungal infections [36].

In summary, by increasing our understanding of essential oils and their use in treating fungal infections, we may improve their effectiveness and perhaps decrease the need for traditional antifungal drugs. Examining the consequences of using essential fish oils in clinical practice for the treatment of skin fungal infections may also prompt a transition towards more environmentally friendly and renewable therapeutic alternatives. Through more investigation and empirical testing, discovered this has the potential to not only aid people afflicted with skin fungal infections but also make a significant contribution to the broader endeavor of diminishing the excessive reliance on antibiotics and antifungal drugs [37]. Such misuse may result in the emergence of drug-resistant strains of fungi.

CONCLUSION: Essential oils hold great promise as a natural and sustainable treatment for skin fungal diseases. They offer a holistic healing method, acting as a substitute for conventional antifungal medications. They also help prevent drug-resistant fungal strains by reducing reliance on antibiotics and antifungal drugs. Essential oils have antifungal, antibacterial, and anti-inflammatory properties, making them effective in treating various skin ailments. They alleviate symptoms associated with fungal infections, such as itching, redness, and inflammation. The use of essential oils can improve skin health and balance, avoiding potential adverse reactions linked to conventional treatments. Further research in aromatherapy could provide deeper insights into the efficacy of essential oils in treating skin fungal infections. By examining different oil combinations and their effects on different fungi, scientists can discover innovative methods to effectively address these common skin problems. Essential oils could become a popular dermatology therapy option, providing a safe and natural alternative for those seeking relief from fungal infections.

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