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Anti-inflammatory and anti-microbial impacts of essential oils

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Abstract: Ethnopharmacology evidence indicates that most essential oils extracted from herbal materials have positive medicinal effects. Some products from species like C.nardus have demonstrated many positive therapeutic activities in the human body. The current study aims to emphasis the anti-inflammatory and anti-microbial effects of essential oils and their possible medical effects in alternative medicine. Information gathered from the search activity is analyzed through a systematic review of previous studies underpinned by the PICO framework. The study established that many of these products exhibit anti-microbial and radical scavenger, anticancer, anti-inflammatory, antiviral, and antioxidant properties, which can help the human body defend against cellular oxidation reactions or pathogens. For instance, volatile oils from *C.nardus* and jasmine have shown potent antioxidant activities against ABTS+• and DPPH cations. The study recommends that future research look at the inhibition of inflammatory signal pathways to expound the anti-inflammatory mechanisms of essential oils.
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1. Introduction

Natural products frequently used in alternative medicine, including volatile oils, are widely used for bactericidal purposes (Salem et al., 2019). On the other hand, Franz and Novak (2020) emphasized that essential oils are attractive sources of anti-tumor and chemo-preventive drugs. Today, ethnopharmacology evidence indicates that ethereal oils have many properties that justify their use in various fields, including being an anti-inflammation agent (Zhang et al., 2021). Along the same line, Intaraphairot and Khaing (2022) hold that these products are potential sources for the development of molecules associated with anti-proliferative activities and anti-microbial effects for the future treatment of cancer. For instance, some products, such as *C. nardus,* are mainly recognized for their anti-microbial, anti-inflammatory, and anti-oxidant properties.

Essential oils, also known as aetheroleum, volatile, or ethereal,are concentrated hydrophobic fluids made of volatile chemical composites extracted from plant compounds (Reddy, 2019). There are more than ninety commonly used essential oils, including lavender, peppermint, sandalwood, chamomile, and bergamot. Each of these oils is linked with specific health claims. For instance, while jasmine is used to help with childbirth, reduce depression, and control libido, tea tree is commonly used to boost immunity and fight infections. On the other hand, ylang-ylang is widely used to treat skin conditions, nausea, and headaches (Pavela et al., 2020).

Previous studies have shown the possible medical effects of some essential oils on the human body (Heuberger, 2020). This study aims to determine essential oils' anti-inflammatory and anti-microbial effects in alternative medicine.

Anti-Microbial Properties of Essential Oils

As supported by Ebadollahi et al. (2020), essential oils extracted from the aromatic plant are commonly used in many industries, especially in the pharmaceutical and food industry, because of their anti-microbial, phytotoxic, anti-oxidant, anti-inflammatory, and neuroprotective properties. Along this line, Datta and Seal (2020) emphasized that these products are associated with low cytotoxicity, reducing intoxication risks.

In the pharmaceutical industry, ethereal oils are potential suppliers of new-fangled active molecules essential in fighting against resistant pathogens, including bacteria and fungi (Bogavac et al., 2022). Similarly, Ebadollahi et al. (2020) underscored that these products could significantly preserve quality characteristics in the food industry. In addition, Zhang et al. (2021) posited that essential oils could be used for encapsulation or as a potential preservative for food packaging.

Anti-Inflammatory Properties of Essential Oils

Khairan et al. (2019) point to inflammation as a host defense mechanism in the human body after its damage when it is infected. It is a defense mechanism against tissue damage or infections (Varga et al., 2017). The scholar holds that when inflammation is not treated in time, it might result in various diseases, including atherosclerosis, cancer, eye diseases, or autoimmune diseases, such as inflammatory bowel diseases. According to Biasucci and Liuzzo (2018), inflammation could cause cardiovascular diseases, Alzheimer's, diabetes, and arthritis.

However, Siddiqui (2021) asserted that volatile oils are natural products from plant extracts that can suppress various forms of inflammation. Singh (2022) supported that essential oils can condense inflammations because they regulate the production of inflammatory cytokines in relaying signals for multiple pathways. For this reason, Gu et al. (2018) supported that these products are anticipated to be used as alternative medicine or as effective therapeutic benefits for anti-inflammatory illnesses. While finding effective drugs for controlling inflammation has been challenging for an extended period, Varga et al. (2017) suggested that today, essential oils have been recognized as the most promising anti-inflammatory drugs.

Problem Statement

Previous studies have shown that essential oils such as rose, lemon, and chamomile are frequently used for therapeutic benefits. According to Mohamed and Salem (2020), aromatherapy has been used for several decades as an alternative medicine in which the healing effects of essential oils are ascribed to aromatic plant extracts. Ethereal oils might help reduce anxiety, relieve stress, improve mood, or induce relaxation (Glassman, 2018). Nevertheless, there is insufficient evidence that volatile oils could treat all conditions efficiently. Friedman (2017) supported that children might be susceptible to the toxic effects of essential oils due to improper use. The scholar holds that improper execution of aromatherapy could cause harmful reactions, including skin irritation, inflammation, or other allergic reactions. Therefore, improper application of essential oils could be poisonous if wrongly ingested or absorbed through the skin.

Aims and objectives of the Study

The study aims to determine the following:

1. The anti-inflammatory and anti-microbial effects of essential oils.
2. The possible medical effects of some essential oils in alternative medicine

Research Question

In children (P), what are the anti-inflammatory and anti-microbial effects of essential oils (I) in alternative medicine (O) compared with adults (C) after twelve months of intervention (T)?

Rationale of the Study

Volatile oils' anti-inflammatory and anti-microbial effects are essential in food and alternative medicine (Abid & Yahya, 2022). The study outcome is helpful for the food and the pharmaceutical industry. For instance, the information gained through this study is crucial for the pharmaceutical industry in that some volatile oils could be potential sources of new medicines, including antiviral, antibacterial, antifungal, antiseptic, anti-parasitic, or anti-oxidant, to fight against resistant pathogens.

2. Methodology

Search Strategy

The study assumes a qualitative research approach to answer its research question. For inclusion and exclusion conditions, the study's data collection technique is directed by the research topic and its weighted problem take in determining the anti-inflammatory and anti-microbial effects of essential oils and their possible medical effects in alternative medicine. The search strategy is carried out through credible search engines such as PubMed, Medline, and DISCOVER. Information gathered from the search activity is analyzed through a systematic review of previous studies underpinned by the PICO framework.

The following key phrases were used to find relevant information for this study: anti-inflammatory effects of essential oils, volatile oils, or ethereal oils, anti-microbial effects of essential oils, aetheroleum, alternative medicine, and aromatherapy. For truncation purposes, the scholar used the terms "anti-inflammatory and anti-microbial effects of essential oils" to filter articles with the most appropriate information for this study.

The search activity was done on 8th January 2023. Using the CASP tool 2019, duplicate records were eliminated by the researcher grounded on their titles and abstracts and through full-text screening. The CASP tool was essential in finding and evaluating the journals to certify they were suitable for the study. As shown in the Prisma-P flowchart, the researcher filtered only scholarly articles or journals with valuable outcomes for the current study. Thus, built on their reliability and eligibility, the researcher filtered the scholarly articles from one hundred and twenty-four articles to nine records by checking for the clarity of their findings and the study objectives.

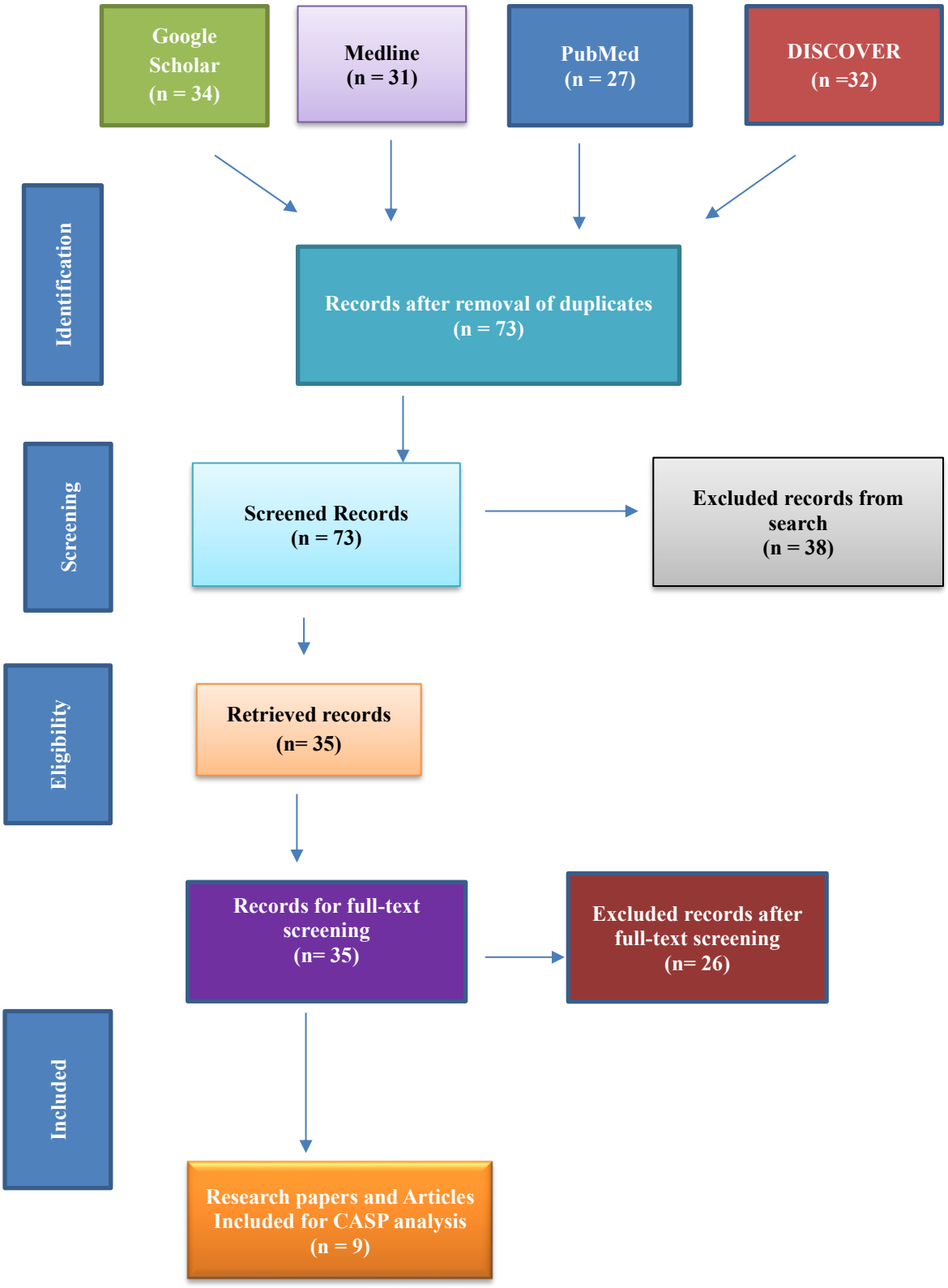

Figure1. The Prisma-P flowchart for Data Collection

Study Selection for Data Extraction

In light of data extraction, the scholar certified that the scholarly journals, articles, and credible research papers were cautiously selected and filtered, steered by the CASP tool to guarantee that only articles with relevant information were included for analysis. Significantly, underpinned by the PICO framework, the search process focused solely on the most credible sources, including peer-reviewed articles, to reduce the number of similar studies.

3. Results and Discussion

Anti-oxidant, Antiviral, and Anti-microbial Effects of Essential Oils

According to Luís et al. (2017), anti-microbial agents are primarily administered as antibiotic medications to control human infections. Besides, Sinha and Pick (2020) asserted that most of these non-herbal products could cause adverse side effects, such as increased reactive oxygen species in the body. Their findings showed that reactive oxygen species are hazardous to body functions, increasing potential health risks. They also play a significant role in developing cancer cells in the body (Pan et al., 2021).

Due to the possible harmful effects of most chemical anti-microbial agents, natural products such as volatile oils would be ideal for treating microbial infections. The current study indicates that most essential oils extracted from herbal materials have shown positive medicinal effects. Some products from species like C. *nardus* have demonstrated many positive therapeutic activities in the human body. Asif et al. (2021) supported that essential oils are recognized for their anti-microbial, anticancer, anti-inflammatory, antiviral, and anti-oxidant properties. In a similar study, Elsayed et al. (2023) established that volatile oils could play a significant role in drug synthesis and development to kill microorganisms or stop their growth due to these properties. These products can be used in various biological applications, including skin regeneration, treatment of neural and cardiovascular diseases in alternative medicine, and cancer therapy.

Furthermore, the current study has revealed that most essential oils are potential sources of diverse medicinal molecules. Kell et al. (2020) supported that many of these products exhibit anti-microbial and radical scavenger properties, which can help the human body defend against cellular oxidation reactions or pathogens. Thus, from ethnopharmacology evidence, it is apparent that ethereal oils, including lavender, peppermint, sandalwood, chamomile, and bergamot,can play a significant role in the development and synthesis of different types of herbal products due to their anti-oxidant, anti-microbial, and antiviral potential for therapeutic benefits.

While the current study showed that plants are potential sources of anti-oxidant molecules, previous studies have highlighted the strong anti-oxidant potential of ethereal oils extracted from medicinal plants. For instance, volatile oils from *C.nardus* and jasmine have demonstrated potent anti-oxidant activities against ABTS+• and DPPH cation radicals (Makkiah et al., 2019). In another study, Nouri et al. (2020) found that gallic acid activity has more significant effects of anti-oxidant, anti-microbial, and antiviral effects in defending the body against pathogens. In addition, Fuhrman et al. (2008) showed that volatile oils from *C. nardus*have anti-oxidant activities, which help the body to protect against various cellular oxidation reactions.

Anti-inflammatory Effects of Essential Oils.

From the analysis, it is apparent that some extracts of essential oils from herbs have anti-inflammatory effects. The study established that volatile oils effectively reduce inflammation as they regulate the production of inflammatory cytokines that enhance the transmission of multiple signals along different pathways. In addition, the study established that the inhibition process of lipoxygenase by most essential oils, including ylang-ylang, lavender, peppermint, sandalwood, chamomile, and bergamot, is concentration-dependent. The results concur with Asif et al. (2021), who established virtually no inhibition at low concentrations of about 0.083 milligrams per milliliter. They revealed that inhibition was noted at a higher concentration of about 2.2 milligrams per milliliter (25 ± 3%).

As Fuhrman et al. (2008) suggested, these anti-inflammatory activities could be well-explained by ethereal oils' high citronellal concentration, which is nearly 33.1%. These results corroborate those of (Elgazar et al., 2019). In addition, previous studies have found strong anti-inflammatory activities of citronellal (Elsayed et al., 2023). Although Elsayed et al. (2023) showed anti-inflammatory activities of monoterpenes aldehydes, Pan et al. (2021) underscored that the specificity of every compound in this group could contribute positively or negatively to increasing or diminishing the inhibition activities.

Of late, it has been revealed that various active components of essential oils can regulate the immune

state of the human body to reduce inflammation (Biasucci& Liuzzo, 2018). The scholar holds that the main components of volatile medicinal oils include a mixture of many compounds, including sesquiterpene and monoterpene. In their support, Luís et al. (2017) emphasized that these products have antibacterial, anti-depression, antianxiety, sedative, acaricidal, antiviral, and anti-inflammatory properties.

Along the same line, Elgazar et al. (2019) emphasized that the anti-inflammatory effect of volatile oils of traditional and alternative medicine is mainly realized through the induction of nitric oxide synthase or various cytokines and through the regulation of cyclooxygenase, which play a significant role in the regulation of the inflammation process.

Anti-proliferative Effects of Essential Oils.

The current study established that the putative anti-tumor characteristics of essential oils are directly related to the anti-proliferative activities of body cells. The results showed that volatile oils inhibit the proliferation of HeLa and LNCaP cancer cells. Anti-proliferative activities of geraniol and citronellal have been reported (Makkiah et al., 2019). However, most essential oils alter cell proliferation due to their high level of monoterpene, which is well-known for its anticancer potential. Thus, volatile oils remain a stable source for identifying biologically active sources for developing molecules associated with anti-proliferative activities and anti-microbial effects for future cancer treatment.

Conclusion and Recommendation

Ethnopharmacology evidence indicates that most essential oils extracted from herbal materials have positive medicinal effects. Some products from species like C. *nardus* have demonstrated many positive therapeutic activities in the human body. The study established many of these products exhibit anti-microbial and radical scavenger, anticancer, anti-inflammatory, antiviral, and antioxidant properties, which can help the human body defend against cellular oxidation reactions or pathogens. For instance, volatile oils from *C.nardus* and jasmine have shown potent antioxidant activities against ABTS+• and DPPH cations. Further research should look at the inhibition of inflammatory signal pathways to expound the anti-inflammatory mechanisms of essential oils.

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