Chapter 31

Use of Essential oils an Alternate Approach against Parasitic Infections

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ABSTRACT

Parasites are potentially harmful organism for both humans and animals. Different treatment protocols have been used to treat diseases caused by parasites. Essential oils are one among them. Essential oils are lipophilic chemical extractions obtained from various plant sources have beneficial effects on human or animal health. Essential oils have been observed to have anti-parasitic properties in various studies. In this chapter therapeutic properties, usage form and effects of some selected essential oils extracted from different plants (Tea tree oil, Lavender oil, eucalyptus oil, Cedar wood oil, Lemongrass oil, Citronella oil, Clove oil, oregano oil, thyme oil and peppermint oil) have been discussed. In addition to these limitations and future prospectus of these oils have also been discussed particularly in the filled of both human and animal parasitology.

KEYWORDS
Parasites, Botanicals, Essential Oils, Therapeutic, Veterinary Medicine, One Health

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INTRODUCTION

Parasites are the organisms causing fatal diseases in both humans and animals worldwide (Shah and Khan, 2019). They not only cause diseases through their infestation but also cause major socio-economic losses (Pisarski, 2019). These organisms are the major threat to public health, and their prevalence is of health importance (Hazards et al., 2018). The concept of one health can play an important role in controlling these disease-causing organisms as many parasites affect both humans and animals or have zoonotic potential (Dafale, Srivastava, and Purohit, 2020; Organization, 2022). Humans have been using essential oils for aromatherapy for centuries and no one can deny the therapeutic advantages of these oils for the treatment and control of diseases caused by different parasites (Akram et al., 2023; Ebani and Mancianti, 2020).

In parasitology, the use of essential oils and their potential therapeutic effects has also been observed and the results achieved on application of these oils in the control of parasites have been impressive (Dawood et al., 2021; Sorour et al., 2018). This chapter discusses the qualities and therapeutic use of several essential oils in treating parasitic illnesses (Panda, Daemen, Sahoo, and Luyten, 2022). These oils have ability to alter the life cycle of parasites by affecting their reproduction, thus minimize transmission to the susceptible host (Baptista-Silva, Borges, Ramos, Pintado, and Sarmento, 2020; Sandner, Heckmann, and Weghuber, 2020).

Essential oils are widely used in parasitology for therapeutic purpose. However, there are some limitations are associated with these oils e.g. proper dosage, concentration and purity for better result and to avoid undesirable effects (Filip Štrbac et al., 2023a; Filip Štrbac, Petrović, Stojanović, and Ratajac, 2021). Although, in filed there is limited use of these oils because of lack of standardization, field application and approval from international agencies like Federal Drug Regulatory Authority (FDA). After proper testing and approval these oils can be added in parasite control and managemental programs all over the world (Yangilar, 2021).

Commonly Used Essential Oils

Tea Tree Oil

"*Melaleuca alternifolia*" commonly known as Tea tree (TT) is a native plant of Australia. Leaves of *Melaleuca alternifolia* used for oil extraction. It is reported that oil extracted from *Melaleuca alternifolia* leaves possess anti-parasitic properties against variety of parasites including, mites, flea and ticks (Boito et al., 2016; Puvača et al., 2019). Oil extracted from TT is applied topically for treatment of ectoparasites like mites and fleas (Gopinath, Aishwarya, and Karthikeyan, 2018). It has been observed that TT oil is an effective remedy against ear mite infestation in pets (Batista et al., 2016). TT oil is also effective against parasite when used on the parasite dwellings (Nascimento, Gomes, Simões, and da Graça Miguel, 2023).

TT oil can also be applied as an antiseptic for cleaning of wounds and prevent maggot growth (Kon and Rai, 2014). It is suggested that before field application some considerations must be practiced towards TT oil use i.e. proper dilution, topical use and supervision of qualified veterinarian(Robinson, 2020). In addition TT oil can be used very carefully as some of the animals species are sensitive to TT oil (Lemmens-Gruber, 2020; Liuwan et al., 2020).

Lavender Oil

Lavender oil (LO) is obtained from the "*Lavandula angustifolia*" flowers. It is reported that LO oil has antiparasitic and antimicrobial properties. LO has repellent power against ectoparasites generally and bugs specifically (Batiha et al., 2023; Crișan et al., 2023). Khan et al., 2024 discussed dermatological applications and significance of LO oil against control and treatment of parasitic infections. In addition to repellent LO is suitable candidate for the treatment and control of ectoparasites including mosquitoes, insects, and vermin (Tăbărașu, Anghelache, Găgeanu, Biriș, and Vlăduț, 2023). LO can be used locally to overcome redness, swelling, irritation and promote healing at site of infection associated with parasites (Irshad, Subhani, Ali, and Hussain, 2020; Malakar, 2024). In addition, it is noticed that LO is also good choice for the treatment of intestinal protozoa for example Giardia in vertebrates and birds (Hüsnü and Franz, 2020).

Eucalyptus Oil

Eucalyptus oil gets from "*Eucalyptus globulus*", which has serious solid areas for fragrance and has strong antiparasitic and antimicrobial effects (Adenubi, Abolaji, Salihu, Akande, and Lawal, 2021; Jafari et al., 2021). This oil additionally makes germ-free and mitigating impacts when applied (Göger, Karaca, BÜYÜKKILIÇ, Demirci, and Demirci, 2020). Eucalyptus oil can reduce parasitic infestation by inhibiting egg hatching and interfering with the developmental stages of helminth larvae (de Godoi et al., 2022). The bug repellent property of this oil is more prominent; consequently, it is by and large used as a bug repellent sprinkle in homes and working environments (Salvatori et al., 2023).

This oil should be used in the right concentrations since it can develop sensitivities and antagonistic responses when ingested in higher fixations (Ahmad et al., 2023). The calming impact of eucalyptus is valuable for applying to wounds with maggot infections (Ahuja, Gupta, and Gupta, 2021; Laudato and Capasso, 2013). Eucalyptus oil could help respiratory prosperity; along these lines, it will in general be used in patients encountering respiratory parasites.

Cedarwood Oil

Cedarwood (CW) oil is derived from different parts of "*Cedrus atlantica*" plant (Chauiyakh et al., 2023). In literature it is reported that CW oil exhibit various medicinal properties. This oil has good fungicidal, molluscicidal and repellent activity against insects (Hammam, El-Shouny, El-Sayed, and Ali, 2017). This oil also exhibits anti-inflammatory properties that makes it a suitable natural remedy against wound caused by ectoparasites (Flor-Weiler, Behle, Eller, Muturi, and Rooney, 2022). Furthermore, (Dolan et al., 2014 and Baker et al., 2018), also reported CW oil as an potent repellent against fleas and mosquitoes. Moreover, CW oil in combination with LG oil, can be used for control of flea in household pets (Nollet and Rathore, 2017). CW oil can also be used as soothing agent against itching and irritation caused by parasites (Vishali, Kavitha, and Selvalakshmi, 2023).

Lemongrass Oil

Lemongrass (LG) oil are extracts of "*Cymbopogon citratus*" plant. Gaba et al., (2020) reported antimicrobial, antiparasitic, antioxidant and anti-inflammatory properties of LG. Patoliya et al., (2022) observed that LG oil is an effective oil for insect control. In addition, LG oil exhibit anthelminthic efficacy in animals as reported by Mukarram et al., (2021). Moreover, LG oil has ability to reduce pain and inflammation (Pelvan et al., 2022). Furthermore, LG oil is a valuable agent used for the treatment of skin infections and wound healing (Li et al., 2020). As LG oil contains caleed citral as an active ingredient that effect on insect nervous systems and disrupt feeding activity of ectoparasites (Patoliya et al., 2022).

Citronella Oil

Citronella (CN) oil is extracted from "*Cymbopogon nardus*" plant. This plant is important due to its high potency against ectoparasites specially bugs (Mahmud et al., 2022). CN oil has proven repellent properties against ectoparasites including mosquitoes, fleas and flies (Agnihotri, Ali, Das, and Alagirusamy, 2019; Lee, 2018). Tadee et al., (2024) have been reported that CN oil effects growth and development of parasites by disrupting their metabolism. In addition to repellent properties CN oil has shown anthelminthic properties against poultry helminths (Raza et al., 2022).

Clove Oil

Clove oil is obtained from the buds of "*Syzygium aromaticum*" plant (Boughendjioua, 2018). Clove oil is customarily known in integrative veterinary medication for its strong antimicrobial and antiparasitic impacts (Panda et al., 2022). Clove oil contains a compound called eugenol, which has expansive range antiparasitic impacts against parasites, including GIT nematodes, ticks, bugs and mites (Hari et al., 2022). Eugenol acts on the nervous system of the parasites and stops metabolic processes, thusly prompting to the death of the parasitic organism (Cox-Georgian, Ramadoss, Dona, and Basu, 2019; Mustapha, 2017). In any case, the oil ought to be utilized in little amounts; consequently, high amounts of oil can create harmfulness in administered animals (Horky, Skalickova, Smerkova, and Skladanka, 2019).

Oregano Oil

Oregano plant oil is extracted from the leaves and shoots of the plant "*Origanum vulgare*" through the process of steam distillation (Knez Hrnčič et al., 2020). This oil is famous among renowned among veterinary parasitologists for its strong antioxidant, anti-inflammatory, and surprising anti-cancer properties (Alekseeva, Zagorcheva, Atanassov, and Rusanov, 2020; Karadayi, Yildirim, and Güllüce, 2020). Its high anti-parasitic potential has attracted the attention of veterinary parasitologists to integrative application of this oil in the field (Palomo-Ligas et al., 2023). Oregano oil can be used in smaller and controlled doses for parasitic control in animals (Filip Štrbac et al., 2022).

Carvacrol an active ingredient present in oregano oil has shown antiparasitic activity against several species of parasites (Mondal, Bose, Mazumder, and Khanra, 2021; Tomiotto-Pellissier et al., 2022). In addition, Milunovich, 2014 and Rostro-Alanis et al., 2019 have been reported anti protozoal and anti nematodal efficacy of oregano oil. Furthermore, a few studies have been presented repellent effect of oregano oil against ticks and fleas (Conceicao et al., 2020; Selles et al., 2021). It is suggested that oregano oil should be used on the reccomendation of veterinarian (Ellse and Wall, 2014).

Thyme Oil

Thyme oil (TO) is derived from parts of "*Thymus vulgaris*" plant. TO contains various compounds. However, thymol which is principal constituent of TO have shown *invitro* antiparasitic (Jarić, Mitrović, and Pavlović, 2015). Thyme oil is an effective botanical remedy against many protozoan species including Trypanosoma, Toxoplasma, Giardia, and Coccidiosis (Hikal et al., 2021; Nurdianti, 2023). In addition to antiprotozoal properties TO is also effective against ascariasis (Özkan, Gökpinar, Sibel, Akanbong, and Erdal, 2023). SO far there is no report on the toxicity of TO (Sisubalan, Sivamaruthi, Kesika, and Chaiyasut, 2023).

Peppermint Oil

Peppermint Oil (PO) is extracted from leaves of "*Mentha piperita*" plant (Ibrahim, Ankwai, Gungshik, and Taave, 2021). Peppermint oil is known in veterinary parasitology for both antiparasitic effects and anthelminthic therapeutic effects (F. Štrbac et al., 2023b). This essential oil can be considered for oral administration in small doses in animals. Peppermint oil can be used as effective alternative for treating gastrointestinal nematodes in sheep (Ferreira et al., 2018). The effects of Peppermint oil against parasites including Dactylogyrus sp. has been proven in research (Harmansa Yilmaz and Yavuzcan Yildiz, 2023). Research has also shown that this oil exhibit effective anthelminthic activity against anisakiasis in animal models (Romero, Navarro, Martín-Sánchez, and Valero, 2014). The dosage of peppermint oil should be controlled and used only if recommended by the specialist (McCaskill, 2021).

Challenges and Opportunities

Essential oils on one hand can be proven potentially beneficial if used in optimum quantities but on the other hand, they can be toxic and even fatal if given in a higher amount than prescribed (Sartori Tamburlin et al., 2021). Essential oils should only be used on the recommendation of a licensed veterinary practitioner, because some essential oils can be beneficial, but one species of animal can be proven toxic or allergic to another (Lanzerstorfer *et al*., 2021). For example, cats may show signs of toxicity even when essential oils are given in small amounts. There is a lack of standardization protocols for dosing and prescribing essential oils and their derivatives in veterinary practice (Silver, Silcox, and Loughton, 2021). This makes it difficult for veterinary practitioners to ensure the safe and optimum administration of essential oils to different species of animals hence reduces their usage in clinical presentations (Nehme et al., 2021). In current scenario, there is a lack of regulatory bodies for ensuring the quality and potency of essential oils that raises concerns about the field application of essential oils in veterinary practices (Jackson-Davis et al., 2023; Kanfer and Patnala, 2021). Essential oils can be utilized as better alternatives to traditional veterinary practices in future as many antiparasitic agents also leave undesirable and harmful effects on animals administered with antiparasitic and anthelminthic drugs (Ramdani, Yuniarti, Jayanegara, and Chaudhry, 2023). These oils can be implemented as an eco-friendly and sustainable approach to controlling parasitic diseases. Many essential oils have specific antiparasitic properties, and many have broad-spectrum potency against parasites and worms (Marjanović *et al*., 2020). Hence, they can be administered for treating a targeted parasitic treatment approach as well as for treating multiple parasitic species infestations. Essential oils can be used for preventive care and as stress-relieving agents against parasitic diseases to improve the overall wellbeing of animals (Darrell, 2022). A reasonable amount of essential oils can be added to animal feed to increase the nutrient profile and as a parasite-preventive strategy in animals (Horky et al., 2019).

Future Research

There is a limited research bank proving the antiparasitic properties of essential oils. There is evidence that essential oils exhibit antiparasitic and anthelminthic properties but are not well defined (Matté, Luciano, and Evangelista, 2023). There is a need to establish proper procedures to testify essential oils use in veterinary medicine following proper application methods and calculation of proper dose (Bunse *et al*., 2022). In addition, further research studies will be carried out to evaluate toxicity of these essential oils in controlled and field conditions (Rojas-Armas et al., 2019; Teke, Elisée, and Roger, 2013).There is a need for the development of assessment protocols through clinical trials describing the efficacy of essential oils for usage in veterinary practices for parasitic diseases. It is crucial to conduct research focusing on the adverse effects and allergic reactions of essential oils, if any, consequently ensuring the safety of these antiparasitic armors (Calvo-Irabien, 2018). It is also important to have trials to investigate the long-term potential effects of essential oils in veterinary parasitology (Nechita, Poirel, Cozma, and Zenner, 2015). There is a huge gap in research and studies on the practical application of essential oils in the field of veterinary medicine for the control of parasites have been observed. This chapter identifies the properties; clinical applications and adverse reactions of commonly used essential oils and paves the way for future research by identifying gaps and by proposing required research implications for the development of these potential natural resources for treating parasitic diseases and improving animal welfare.

Conclusion

Essential oils are one of the options used for the treatment of parasitic infections in filed along with other treatments regimes and protocols if administered under the supervision of veterinary and health practitioner. They can be used generally and specifically for the treatment and control of parasitic infections. On the basis of literature review and studies conducted so far, it is generally concluded that essential oil extracted from plant sources are one of the best alternatives to synthetic ant-parasitic agents. In addition to this there is minimum chance of anti-parasitic resistance associated with these essential oils. Veterinary health professional must communicate to the farming community about the safe usage of these oils against parasitic infections.

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