

Chapter 32

Essential Oils as Alternative Treatments for Common Parasitic Infections in Animals

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ABSTRACT

Essential oils are reported to be effective for the natural, alternative treatment of common parasitic infections in animals. These are plant derivatives endowed with properties against the parasitic population, anti-inflammatory, and antimicrobial properties that could reduce reliance on synthetic chemical treatments. These oils have been shown to have effects against a number of ectoparasites, such as ticks, fleas, and mites, and endoparasites, such as roundworms and hookworms. These varied active compounds from the essential oils act on the different pathways of the parasites, causing a hindrance in their life cycles, reproduction, and host-infesting ability.

Among the main benefits that have been derived from the use of essential oils are reduced risks of resistance to parasites and, in some cases, synergistic effects when applied in combination with other natural compounds or conventional drugs. These would, however, come with major challenges requiring quality control of oils with variable compositions, possible animal toxicity or side effects, correct dosing and administration recommendations, and suitability for a large-scale production setting. Comprehensiveness in aspects such as safety, modes of action, and clinical trials is necessary for their development.

The essential oils are not an absolute substitute for veterinary care, but they are quite promising in a complementary approach, and it is under professional guidance that they should be used judiciously. These limitations can be taken care of by rigorous study, standardization, and collaboration with stakeholders to uncover the applications of these natural remedies in the fight against parasitic infections and in promoting animal health and well-being. In this regard, continuous research will disclose several sustainable options for parasite control.

KEYWORDS

Essential oils, Parasitic infections, Antimicrobial properties, Resistance reduction, Animal toxicity

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INTRODUCTION

Essential oils have gained importance as alternatives for the management of several afflictions in both humans and animals (Koul, Walia, and Dhaliwal, 2008). Although the aromatic properties of these plant-derived oils have been used extensively, their prospects in medical applications, especially as alternative treatments for common parasitic infestations in animals, are becoming more and more interesting. Parasites can become serious health hazards in animals, affecting growth, behavior, and well-being. Most of the conventional approaches are based on the use of synthetic chemicals and hence have negative effects. Essential oils stand out as a natural approach that may reduce our dependence on synthetic compounds (Sarkic and Stappen, 2018).

The applied essential oils to the parasitic infections in animals are all extracted from different plants, all with specific characteristics. Some widely known ones are tea tree, eucalyptus, lavender, and peppermint (Ellse and Wall, 2014). These oils have been noticed as anti-parasitic, anti-inflammatory, and antiseptic properties, which have made them quite

attractive in comparison to traditional treatments (Upadhyay, 2010). The key point to their efficiency is in their active compounds, such as terpenes, which are known for their biological activities (Maimone and Baran, 2007).

The entire gamut of animal health problems is caused by different kinds of parasites (Smith, 1970). Classic chemical treatments are effective, but side effects and resistance make alternative, more natural solutions necessary. In this sense, evidence is also given for the potentials of essential oils, considering that many of them have antiparasitic properties that can be exploited for the treatment and prevention of the most common parasitic infections in the animal world (Ramdani, Yuniarti, Jayanegara, and Chaudhry, 2023).

Among the most researched anti-parasitic agents in the essential oils is neem oil (Etewa and Abaza, 2011). Neem oil is obtained from the tree of neem. It has been widely used through generations in the field of traditional medicine, especially in India and other parts of Asia, to carry out its insecticidal, anti-inflammatory, and antiseptic activities. Scientific research has indicated that this oil has the ability to fight off several parasites such as ticks, fleas, mites, and intestinal worms (Selles et al., 2021).

The active ingredient in neem oil is azadirachtin along with other limonoids, which is known to disturb the life cycle and reproduction of the parasite, acting as feeding and molting deterrents (Muhammad and Kashere, 2020). For instance, neem oil has killing and repelling effects on ticks, fleas, and mites. It holds the potential as an alternative method to conventional chemical acaricides or treatments administered against ectoparasites (Gupta, Doss, Srivastava, Lall, and Sinha, 2019).

Additionally, neem oil has been found to act against internal parasites, namely roundworms and hookworms (Sunita, Kumar, Khan, Husain, and Singh, 2017). Given orally or applied topically, neem oil kills these parasites inside the animal's body, thus reducing the likelihood of gastric parasites and other health-related problems associated with internal parasitic infestations. Another major essential oil that will be focused upon is that of the clove plant, *Syzygium aromaticum*, which is highly rich in eugenol, a compound of very strong antibacterial, antioxidant, and anti-inflammatory activity. These factors make the oil of the plant very interesting for treatment of parasitic infections in animals (Gurib-Fakim, 2006).

Other studies have reported clove oil to have proved as an effective acaricide in killing and repelling several ectoparasites, including ticks, fleas, and mites, on contact. Due to its strong smell and insecticidal characteristics, it has the potential to be an ideal natural repellent, and animals do not contract the parasites (Mele, 2020). Secondly, it has been shown effective against internal parasites, especially roundworms and hookworms, so it can be used against gastro parasitism treatment. The other very important essential oil is garlic oil, which is likely to harbor some potential benefits as an antiparasitic. *Allium sativum*, popularly known as garlic, is one of those plants that have been known to harbor several medicinal uses since time immemorial. In addition to its medicinal uses, its oil has several sulfur-containing compounds, such as allicin, that exerts strong antimicrobial and anti-inflammatory effects (Lemar, 2005).

The studies confirmed the effect of garlic oil on a vast spectrum of parasites, from ticks and fleas to mites and intestinal worms. Some components in the oil will interfere with the life cycle and the ability of the parasites to reproduce; hence, they shall not be able to survive in or on the host animal (Hrckova and Velebny, 2012). In addition, garlic oil may stimulate the animal's immune system in the fight against parasitic infection. Although essential oils have been reported as a potential natural alternative in the treatment of animals' parasitic infection, the effectiveness of essential oils may vary with the host species, dosage, method of administration, and individual host response. Therefore, it is important to consult with a veterinarian or animal health professional prior to the inclusion of any essential oil in a treatment protocol for parasites (Singh, Gupta, and Singh, 2004).

Essential oils should be applied correctly on animals, in the right dosage, and with the right procedure (Tisserand and Young, 2013). Many of the essential oils are highly concentrated and can cause irritation or be toxic in inappropriate dosages. Often, it is recommended to dilute them into carrier oils, such as coconut or almond oil, which further helps in reducing the risk for any adverse reactions. Also, there should be the consideration in the method of application as well as the specific invasion of the parasitic disease or the totality of health condition of an animal (Stevanović, Bošnjak-Neumüller, Pajić-Lijaković, Raj, and Vasiljević, 2018).

Of significant note is the possibility of the interaction of essential oils with other drugs or treatment. Some could interfere with the drugs or potentiate their action, leading to side effects or lack of effectiveness. The veterinary officer should be informed of all other drugs and treatments the animal is on before using essential oils in the management of the animal (Edris, 2007).

Moreover, reputable suppliers are there to be found, and they can always ensure high quality, pure essential oils. Poor extraction or even adulteration of the oils has the potential to create contaminants within the oil or to reduce the amount of available active ingredients, therefore reducing efficacy and potentially causing harm to the animal. However, their use to treat common parasitoses in animals should be approached with care and under the guidance of a veterinary professional. Suitable doses, methods of application, and the potentiality of the interactions and adverse effects must be considered before safe and effective application of any natural medicine (Tisserand and Young, 2013).

Research on the mechanisms of action and optimal application of these various essential oils in the treatment of parasitic infections of animals continues to provide revealed scientific evidence to support more practical application of essential oils within conventional treatment protocols and, most likely, further the health and well-being of animals while reducing the use of synthetic chemical treatments (Bassolé and Juliani, 2012). In addition to the anti-parasitic potential, most essential oils possess an antimicrobial, anti-inflammatory, and analgesic effect, adding value in relation to the

treatment of secondary problems to the parasitic infection, such as skin irritation, inflammation, and pain (Chouhan, Sharma, and Guleria, 2017).

For example, lavender oil is believed to be calming and also carries some extremely powerful properties in the case of anti-inflammatory and analgesic actions. Added to the therapies against parasites, it will aid in the reduction of pain and inflammation in the skin associated with these organisms, helping the affected animal heal more quickly and be less stressed (Grecu, Henea, Trifan, and Rimbu, 2021).

For instance, while tea tree oil has been studied extensively for its potent antimicrobial and anti-inflammatory activity, it can possibly exert an anti-parasitic effect. This all-purpose oil can prevent secondary bacterial or fungal infection due to skin irritation or open wounds created by parasites and offer a fuller scope of treatment of these infections (Lam, Long, Griffin, Chen, and Doery, 2018).

For instance, thyme (*Thymus vulgaris*) essential oil contains many monoterpenes, thymol, and carvacrol, which have been highly efficacious against a wide range of parasites, including ticks, fleas, and intestinal worms (Gonçalves et al., 2017). Indeed, this can potentially interfere with membrane permeability, enzymatic activities, and energy production in the parasites, thus offering difficulty in developing resistance due to the multiplicity of action (Sardari, Mobaiend, Ghassemifard, Kamali, and Khavasi, 2021).

In the same way, oregano essential oil from *Origanum vulgare* has high amounts of phenolic compounds, mainly carvacrol and thymol, together with other terpenes such as p-cymene and γ -terpinene. These different compounds act in a synergistic way in the different aspects of the physiology and metabolism of the parasite, which can reduce the likelihood of resistance development (Štrbac et al., 2022).

The advantage of EO-based alternative treatments may rely on the possibility of synergistic interactions of EOs with other natural compounds or with conventional treatments. Therefore, the beneficial effects of the essential oil-based treatment, used in combination with other natural remedies and selective conventional treatments, might have an additive effect on the control of the parasite population with a low risk of resistance development (Ju et al., 2022).

For instance, synergistic effects regarding combinations of essential oils and plant extracts, or other natural molecules, have been studied. The combination of thyme essential oil with grapefruit seed extract has shown good results against a wide spectrum of parasites, including ticks and fleas. This combination may potentiate their anti-parasite activity at lower concentrations compared with the individual components (Yuk, 2021).

Moreover, they may be combined with conventional treatments so that the fight against resistance can be ascertained. Essential oil treatments, in rotation or in combination with synthetic chemical treatments, may target the parasites from different fronts, thus reducing selective pressure and extending the life of conventional treatments by lengthening the time until the development of resistance to them (Isman, Miresmailli, and Machial, 2011).

It is worth noting, however, that the use of essential oils as alternatives for treating parasitic infections in animals still remains at its infancy stage, and more research studies are needed to elucidate further the mechanisms of their action, to find the ideal formulations, and eventually establish their interaction with other treatments (Alviano and Alviano, 2009).

This consideration, therefore, brings to significance the role of standardization and quality control when using essential oils for therapeutic purposes. Essential oils may have varying composition and strength because of factors such as the species of the plant, the growing conditions, extraction procedures, and storage conditions among others. These variations might interfere with efficacy and safety hence the need for high-quality standardized products that were derived from reputable suppliers (Sachan, Sachan, Kumar, Sachan, and Gangwar, 2010).

Furthermore, care and caution are taken when applying and dosing the oils according to the veterinary officer's opinion. Essential oils are very concentrated; therefore, if applied incorrectly, they can lead to toxicities or even adverse reactions. Dilution, application methods, and calculations on the dosage follow to make sure the application of these natural remedies is safe and effective (Hanif, Nisar, Khan, Mushtaq, and Zubair, 2019). Consider also that there are some animals which are not compatible with treatments based on essential oils, and the efficacy depends on the type and degree of the parasitic infection.

The consultation of the pet and animal owner with qualified veterinarians or equally competent animal health professionals on the use of essential oils in their program of treatment in the animals concerned cannot be overemphasized. These said professionals shall also assist them in the selection, dosing, and proper utilization of the essential oil relevant to their needs (McCaskill, 2021). Likewise, more research should be done, along with the collaboration of veterinary experts, researchers, and other professionals who have knowledge in essential oils, to gather more information on potential application and limitations of EO products.

While there is great potential in the use of essential oils as alternative treatments in common parasitic infections in animals, caution in their use and professional guidance regarding scientific rigor is in order. Integrating traditional veterinary care with evidence-based practices of integrating essential oils and other natural remedies is going to help us advance overall health in animals and deal with the growing concern of resistance to conventional, pathetic chemical treatments (Bakkali, Averbeck, Averbeck, and Idaomar, 2008).

Since more and more research is being directed toward the anti-parasitic activity of essential oils, it becomes obligatory to take into account the parasite-destroying potential of natural compounds against specific parasites. Essential oils of different plants have been tested against different parasites and have been shown to possess variable potentials. The knowledge of such specificities becomes very important to help in developing targeted treatment strategies

(Azadbakht, Saeedi Akbarabadi, Motazedian, Monadi, and Akbari, 2020).

The most important group of parasites for which the treatments with EO have been widely studied is the ectoparasites, including ticks, fleas, lice, and mites. These parasites because considerable physical annoyance, skin irritation, and may, through this discomfort and irritation, be transmitting a disease to the host animal, therefore high priority is given to measures that control them (Selles et al., 2021).

Some of the essential oils with a potential role in the control of ectoparasites include neem, tea tree, and lavender essential oils (Gupta et al., 2019). They have evidenced strong potential for having insecticidal and repellent activities against ticks and fleas. Essential oils can interrupt the life cycle of these parasites and keep them from infesting animals, thus reducing the incidence of potential tick-borne diseases (Eteawa and Abaza, 2011).

Other parasites that fall into this class, treatable by the same treatments, are the endoparasites in nature, which include the intestinal worms, such as roundworms, hookworms, and tapeworms. These internal parasites cause serious gastrointestinal disturbances, malnutrition, and in general, poor health if untreated (Braga de Oliveira et al., 2021). Other essential oils with good potential as anti-helminthics include garlic, wormwood, and clove. These contain active principles that suppress the survival and reproduction of intestinal worms (ND, DeGrandpre, and DeGrandpre, 2010).

It is worth noting that EO can also be effective in the treatment of some parasites, depending on the species, life stage, concentration, and application method. There is, therefore, a need for further targeted research and clinical evaluation to establish the optimal formulation of EOs and a treatment protocol for many types of parasitic infections (Ellse and Wall, 2014).

Another advantage of using essential oils for alternative treatments is that they can be blended for possible synergistic effects or possibly in combination with other natural compounds, or with conventional treatments. A few studies report synergistic anti-parasitic activity of combined blends of the oils; combined effects of a number of oils were much better compared to combined effects of their individual effects (Miller, 2020).

An example is the blend of thyme, oregano, and clove essential oils, which showed increased anti-parasitic activity against the activity of different ecto- and endoparasites compared to the single oils. The broad spectrum of active ingredients in these oils may act in a concerted way, thus increasing the overall effect in a synergistic manner on various pathways in the parasites (de Almeida et al., 2023).

However, in most cases, essential oils are combined with other bioactive natural compounds, for example, plant extracts or phytochemicals, to possibly increase their activity in anti-parasitic effects. For example, neem oil could be combined with the extracts from other plants, such as wormwood or black walnut, to multi-targetedly work on intestinal worms. Apart from their anti-parasitic property, their immunomodulatory effects could potentiate this therapeutic effect. Essential oils, including frankincense and myrrh, stimulate immune responses and promote normal immune health in animals (Diniz do Nascimento et al., 2020).

Thus the use of such essential oils in therapeutic regimens is probably useful not only directly against the parasites but also for potentiation of natural defense mechanisms of the animal, which would enhance the ability to resist and recover from parasitic infections (Edris, 2007).

However, it is cautious to use a mixture of essential oils or in combination with other natural compounds or conventional treatments. In the latter case, the possible interactions, contraindications, and the establishment of an appropriate dosing and administration protocol need to be adequately evaluated by the guidance of veterinary professionals to be safe and effective (Seow, Yeo, Chung, and Yuk, 2014).

As research in this area advances, the rigorous scientific studies, which should be conducted to validate the antiparasitic effects of essential oils and to develop evidence-based treatment protocols, should be conducted. Also, very important, to improve our knowledge about the possible applications and limitations of EO as a real treatment alternative to common parasitic infestations in animals, is that the collaborations of veterinary researchers with EO experts together with animal health professionals have to be enhanced. While the antiparasitic potentials of the essential oils bring hope to alternative treatments, their use might be met with some challenges and limitations. Understanding such challenges is a way for researchers and veterinary professionals to approach the development of more effective and safe applications of essential oils in combating parasitic infections in animals (Dawood et al., 2021).

This is one of the main problems with the use of essential oils in alternative treatments: there is variability in their composition and quality. Essential oils are complex mixtures of volatile compounds, and their chemical composition may greatly differ depending on the botanical source, geographical location, growing conditions, extraction methods, and storage conditions. This will result in variations in their potencies and effectiveness, which makes it hard to standardize any treatment protocol (Zuzarte and Salgueiro, 2015).

The two major considerations, during the synthesis of essential oils for therapeutic uses, include standardization and strict quality control. This may be achieved, for example, by the employment of analytical methods such as GC-MS to establish the chemical composition of the essential oil accurately in order to achieve batch-to-batch consistency. The employment of standardized extraction and processing methods could also minimize variability of the end product (Daferera, Ziogas, and Polissiou, 2000).

Other problems that can occur are possible adverse reactions and toxicity with the use of essential oils in animals. Most of the essential oils are generally recognized as safe in humans; however, the safe margins in animals may be different because of the variations in metabolism, absorption, and sensitivity. Some of these may be toxic with the

application at high concentration topically, or in some species when ingested. Such potential risks can be offset through safety studies in their entirety, researching the potential toxicity and undesired effects of the oils in animals. Factors that need to be researched include lethal doses and organ-specific toxicity, in addition to interactions that could possibly be instigated from other medications or treatments. Safe dosing, dilution, and methods of application need to be put into place and advised appropriately by the veterinary professional (Lemmens-Gruber, 2020).

Another challenge is the administration and dosage of the essential oils, which is properly diluted since they are of a high concentration and potency. They cause ineffective treatment or even damage to the animal because of the wrong application or dosing. Proper calculation of dosages to be used, based on the weight and condition of the animal, is very important. Proper and safe veterinary application of essential oils in the treatment of parasitic infections in animals is assured when experts in essential oils are part of the team that determines appropriateness, dosage, and method of administration as well as considers the parasitic infection and the status of the animal. Such close collaboration between the essential oil expert and the veterinarian may be considered a bridge between traditional knowledge and modern scientific understanding to secure a responsible, evidence-based use of natural remedies (Tisserand and Young, 2013).

Besides, the risk of developing resistance to essential oils should not be underestimated. Although essential oils provide a very good alternative to the conventional treatments with chemicals, their massive, non-selective use could lead over time to the selection of parasites that develop resistance. Strategies to decrease the development of resistance, such as rotation or integration into more conventional treatments, should be researched and implemented (Woolf, 1999).

However, there may be limits to how scalable and accessible these treatments are, as the numbers of animals being produced or farmed are very large. However appropriate they are for an individual pet owner or small-scale operation, their cost-effectiveness and practical use at a higher level of implementation need to be scrutinized and optimized (Marincaş and Feher, 2018).

In conclusion, it is also important to remember that essential oils are not a total replacement for the conventional care and treatment through a vet. This means that complementary treatments and/or alternatives to be used with the traditional methods should be under the guideline of competent veterinary professionals. An integrative approach to holistic care could possibly combine the beneficial features of both the conventional and alternative therapies and offer the most effective strategy in the management of parasitic infections in animals (Tisserand and Young, 2013).

This will only be achieved if these challenges are looked at with lots of research, standardization efforts, and also collaboration of different stakeholders in the process. Essential oils will therefore be able to achieve their full potential as alternative treatments of common parasitic infections in animals, hence improving animal health and welfare.

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