Evaluation of Anthelmintic Activity of Medicinal Plants against Toxocaiasisi

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Abstract

Toxocara canis and *Toxocara cati* are zoonotic parasite infections that cause toxocariasis, which is an important risk to both humans and animals worldwide. Alternative treatment strategies must be considered due to helminths' increased resistance to traditional anthelmintic therapies. The many bioactive chemicals found in medicinal plants present a potential path toward the development of natural anthelmintic drugs. This study evaluated the anthelmintic activity of several medicinal plants against *Toxocara* species. Crude extracts and obtained phytochemicals were evaluated for their ability to inhibit the movement of *Toxocara* adult and larval stages, decrease larval development, and cause death. Climate change, changes and increased human and canine populations will all contribute to the global importance of this zoonosis. Review the epidemiology, control, clinical symptoms, transmission, diagnosis, and current research related to *toxocariasis*. Other *T. canis* control measures include frequent regular anthelmintic treatment of cats and dogs, initially at a young age; dog legislation; education; and enforcement of laws on the disposal of puppy feces, as well as personal hygiene. *T. canis* can be difficult to control due to the presence of wild definitive and paratenic host species. Results evaluated that several plant extracts show anthelmintic activities to the presence of alkaloids, flavonoids and terpenoids.

Keywords: Evaluation, Anthelmintic activity, Medicinal plants, *Toxocara canis*, *Toxocara cati*, Toxocariasis

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Introduction

Toxocariasis is the most common zoonotic disease in humans both affecting cats and dogs (Waindok et al., 2021; Al-Ghabban, 2023). In dogs and cats, *Toxocara canis* and *Toxocara cati* are the etiological agents for toxocariasis (Rostami et al., 2020; Zheng et al., 2020). *T. canis* & *T. cati*, also known as intestinal roundworms, are members of the family Ascarididae (Magistrado, 2020; Wangchuk et al., 2020; Camacho-Giles, 2024). The life cycle phases of *T. canis* are completed in both definitive hosts, such as dogs and other canids, and paratenic hosts, such as humans and other mammals (Waindok et al., 2021; Mendoza Roldan & Otranto, 2023). *T. canis* can infect both pups and adults; however, the infection in adults is less severe than in puppies, and it usually occurs as moderate or asymptomatic diarrhea (Saichenko et al., 2021; Schwartz et al., 2022). Puppy signs and symptoms can be very severe, including diarrhea, vomiting, liver enlargement, retarded growth and development, and other problems (El-Saber Batiha et al., 2020; Morelli et al., 2021). Young puppies need prophylactic therapy and treatment for *T. canis*, as the infection can be fatal if caused uncontrolled (De Bonis et al., 2021; Uchanska et al., 2022).

The life cycle of *T. cati* is completed in both definitive (cats) and paratenic (mammals and birds) hosts (Aleem et al, 2024). The feline roundworm, or *T. cati*, affects both domestic pets and wild cats (Holland, 2023). As the parasite's maturity stage is found in the host's intestines, infections in adult cats usually cause an absence of symptoms (Ursache et al., 2021). However, young kittens are affected by very serious and fatal disease (Mendoza Roldan & Otranto, 2023). Toxocariasis in dogs and cats is being treated with several types of drugs (Dantas-Torres et al., 2020) however; it results that the parasite got immune and developed resistance to these drugs. The main problem with using those treatments is that resistance is increasing (Chinemerem-Nwobodo et al., 2022; Sarfaraz et al., 2024; Zulqarnain et al., 2024; Sarfaraz et al., 2025). This parasite has somehow become resistant to present treatments; therefore, we will need to focus on the development of new treatments that are both effective against the *Toxocara* and have an extremely high safety rate in the human body (Liu et al., 2020; Paliy et al., 2021; Asghari et al., 2022). In this chapter we will discuss the life cycle and medicinal plants against *toxocariasis*.

1. Life cycle of *Toxocara* spp

All wild and domestic dogs are infected by *T. canis*; however, pups are more severely affected than adults (Khatoon, 2024). Both

domestic and wild cats are also infected with *T. cati*. But compared to adult cats, kittens are more susceptible to viral infection (Dantas-Torres et al., 2020; Bonilla-Aldana et al., 2024). *Toxocara* species can have either an indirect life cycle, which involves many hosts, or a direct life cycle, which is just one host (Nijsse et al., 2020; Holland, 2024). Eggs are shed in the definitive host's excreta during the initial stage of the life cycle (*T. cati*: felines; *T. canis*: canids) (Velusamay et al., 2023; Udainiya et al., 2024). The embryogenesis and infectious stages of eggs, which contain L3 (the third larval stage), require a period of one to four weeks (Jaramillo-Hernandez et al., 2020; Whitcup & Sen., 2021; Schwartz et al., 2022). When the definitive host ingests these infectious eggs, the eggs hatch, and their larvae enter the gut wall (Morsy, 2020; Wu & Bowman, 2020). In cats (*T. cati*) and young dogs (*T. canis*), the larvae migrate by the bronchial tree, esophagus, and lungs before coughing up and entering the gastrointestinal tract. This arrested larva is reactivated in female dogs in the late gestation stage, infecting the puppies through the placenta and the mother, and the adult worms migrate in the small intestine (Ziegler & Macpherson, 2019; Jaiswal et al., 2023).

The *Toxocara* species could complete its life cycle indirectly by consuming paratenic hosts (Holland, 2023). The infectious eggs are digested by paratenic hosts, where they hatch and penetrate the intestinal wall (Christaki, 2020; Chavez-Ruvalcaba et al., 2021). When infectious eggs are consumed by paratenic hosts, they hatch there and enter the gut wall (Carrero et al., 2020; Hailu et al., 2020). The larvae's life cycle is finished when they are consumed by the definitive host in the paratenic hosts' tissues to develop into adult worms in the small intestine (Tielens & Van den Bergh, 2020; Morley, 2022).3.

2. Prevalence of *Toxocara*

Toxocara species infect 5–20% of people worldwide (Smith & Noordin, 2006). Tropical and subtropical areas have the highest prevalence. The United States seroprevalence rates are 10–30%, (Rostami et al., 2019) Brazil are 20–50% (Liao et al., 2010) , Argentina are 15–30%, 10–30% in Italy 5-20 in Germany, (Roldan et al., 2010) and 2-10% in the UK, China seroprevalence is 10–40%, (Chen et al., 2018) Japan is 20–50%, and India is 15–30% (Hotez, 2008). In Nigeria, seroprevalence was 20–50% (Schoenardie et al., 2013), while in South Africa; the range is 10–30% (Fakhri et al., 2018). Several studies showed that the Germany have reported the prevalence of these nematodes in dogs and cats, with rates of 6.1% and 4.7%, respectively (Barutzki & Schaper, 2011).

3. Public Health Importance

Toxocariasis is a significant public health problem; however, it is not classified as an infectious disease that can be easily diagnosed. A recent web-based survey conducted among eye specialists collected epidemiological, demographic, and clinical data on patients diagnosed with ocular larva migrans (OLM) in the United States (CDC, 2011). The survey revealed that 68 cases of OLM were diagnosed between September 2009 and September 2010, with 57% (25 patients) living in the southern region. The median age of the patients was 8.5 years, ranging from 1 to 60 years. Vision loss was the most commonly reported symptom, affecting 83% (25 patients), of whom 68% (17 individuals) experienced permanent vision loss. The survey demonstrated the effectiveness of web-based methods for gathering national data, which could potentially be applied in other countries. *Toxocariasis* imposes a substantial societal and individual burden, even in a wealthy nation like the United States, as evidenced by its high prevalence rate of 13.9% and an estimated 1.3 to 2.8 million infected individuals (Hotez, 2008). Along with other helminth infections, such as strongyloidiasis, *ascariasis*, and cysticercosis, *toxocariasis* is classified as a neglected tropical disease that disproportionately affects individuals living in poverty. These infections perpetuate cycles of poverty across generations and demand urgent attention (Hotez, 2008; Hotez, 2013). Studies on the potential benefits of controlling these infections suggest that targeted interventions could lead to significant improvements in human health and livestock productivity, such as those seen with *T. vitulorum* in animals.

4. Socioeconomic Factors

Several factors influence the prevalence and impact of *toxocariasis*, particularly access to clean water, sanitation, and healthcare (Farmer et al., 2017). Higher infection rates of *toxocariasis* are more likely in areas with inadequate sanitation infrastructure and limited resources for deworming. Without proper sanitation, the environment becomes more contaminated with *Toxocara* eggs, increasing the risk of transmission. Efforts to improve public health, such as better sanitation, education on hygiene practices, and regular deworming, are essential in reducing the prevalence of this parasitic disease (Tyungu et al., 2020; Ketzis & Lucio-Forster, 2020). The main cause of risk for human beings *toxocariasis* has been obtained into exposure to dog and cat faeces in the environment. These include low socioeconomic status, poor hand hygiene, nail-biting, owning pets such as dogs or cats, having parents with limited educational backgrounds, playing in sandpits, or consuming raw or undercooked meat contaminated with encapsulated larvae from domesticated animals like cow (Lee et al., 2014). A case of cerebral *toxocariasis* was identified, associated with the consumption of raw duck liver. This organ is often one of the most severely affected by the disease, as it drains portal venous blood containing a larger amount of larvae. Some diseases in humans can be caused by consuming contaminated dog hair (Cortes et al., 2015; Rubinsky-Elefant et al., 2011). According to several studies, a specific type of pica known as geophagia, which involves the consumption of soil, has been identified as a risk factor for *toxocariasis* (El-Sayed & Ramadan, 2017).

5. Use of Medicinal plants against *Toxocara* spp.

Throughout history, people have used various plant components to treat many kinds of conditions. Presently, studies focus on a specific component found in several plant parts (Simone, 2010). The treatments for *T. canis* and *T. cati* include many kinds of plant chemical substances. This characteristic of botanicals encourages studies to research plant extracts to create effective treatments for the control and cure of many kinds of parasitic diseases (Sheikh et al., 2023). Both ethanolic and aqueous extracts from *Macrocepis diademata* and *Alseis yucatanensis* showed great efficacy in preventing *T. canis* larvae (Oliveira et al., 2017). Extracted from *Cucurbita maxima*, linoleic acid

prevented the parasite from developing into an adult by inhibiting its larval stage. These plant extracts may interfere with the parasite's energy mechanism, which causes its death as a larva (Tagboto & Townson, 2001). Secondary metabolites such as tannins, flavonoids, saponins alkaloids, and glycosides can be used to treat *Toxocara* spp. Several curcuminoids and piperamides, including palasonin, ascaridole, asarone, thymohydroquinone, kaurenes, quercetin, and pyrethrin, have been isolated from different components of plants (Parugrug et al., 2022). Both dogs and cats with *Toxocara* infections can be treated with botanical cures.

6. Treatment

Because neurotoxocariasis is a common condition, there are generally few well-controlled studies on its treatment. Diethylcarbamazine (DEC), albendazole, mebendazole (MBZ), and thiabendazole (TBZ) have been used with a variety of effects in treating toxocariasis with neurological problems (Ortiz-Pérez, 2021; Lam et al., 2018). Clinical signs of VLM decreased by 50% with TBZ at a dose of 25–50 mg/kg for 3–7 days and with MBZ at a dose of 20–25 mg/kg every day for 3 (Chen et al., 2018).

7. Prevention

Infection of humans with *Toxocara* has become more prevalent due to the rapid increases in dog and cat individuals, particularly untreated feral and stray animals, and their proximity to humans (Deplazes et al., 2011). Thus, precautions against first environmental contamination should be included in infection prevention strategies (Overgaauw & van Knapen, 2013).The transfer of *Toxocara* eggs from animals into humans can be inhibited by implementing a variety of mechanisms. These involve commonly and from young ages deworming domestic animals. Since they are most affected to transmit the disease, pregnant bitches, pups, and kittens need particular treatment and preventive anthelmintics. Pet owners ought to collect and properly dispose of their pets' waste prior before the eggs become infectious. To break the cycle of toxocariasis transmission from dogs to soil to humans, the World Health Organization (WHO) released helpful recommendations for disposing of the feces of fatigued dogs and cats. Hand washing after interacting or playing with dogs or after being placed in potentially contaminated surroundings may also prevent infections in humans. Children should learn basic habits of personal hygiene from their parents, including the need to wash their hands often and the risks of consuming dirt. Other therapies have been tried in experimental animals and might offer alternatives to the mentioned methods for preventing toxocariasis (Basualdo et al., 2007; Malheiro et al., 2008; Chiodo et al., 2010).

Conclusion

An important zoonotic disease that affects both people and animals is toxocariasis, which is spread on by the parasitic nematodes, which include *Toxocara canis* and *Toxocara cati*. Alternative methods of treatment are of critical importance due to an increasing number of drug-resistant helminths. This study evaluated the anthelmintic potential of medicinal plants, focusing on their ability to *Toxocara* species through various mechanisms, including larval inhibition, mortality, and disruption of adult parasite motility. The findings demonstrated that several medicinal plants possess strong anthelmintic activity, which can be contributed to their diverse bioactive compounds, such as alkaloids, flavonoids, tannins, saponins, and terpenoids. These phytochemicals likely act through multiple mechanisms, such as impairing parasite metabolism, disrupting cell membranes, or interfering with key biochemical pathways, causing to parasite death. Medicinal plants offer significant advantages, including their natural origin, reduced likelihood of inducing resistance, and environmental safety. In conclusion, the anthelmintic activity of medicinal plants represents an approach to the global burden of toxocariasis and mitigating the challenges posed by drug resistance.

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