

Q-A3

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1 RESEARCH



2 **Encapsulation of Carvacrol and Timol with yeast cell wall**
3 **and its repellent activity against *Amblyomma sculptum***
4 **and *Rhipicephalus sanguineus* (Sensu Lato)**

5 Jhone Robson da Silva Costa¹ · Tassia Lopes do Vale¹ · Geovane Ferreira da Silva¹ ·
6 Naylene Silva Sales Cavalho¹ · Aldilene da Silva Lima² · Lívio Martins Costa-Junior¹ ·
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Q- A2



REVIEW

**Inhibition of vertebrate complement system by
hematophagous arthropods: inhibitory molecules,
mechanisms, physiological roles, and applications**

Maurício Roberto Vianna Sant'Anna, Adalberto Alves Pereira-Filho, Antonio Ferreira Mendes-Sousa,
Naylene Carvalho Sales Silva, Nelder Figueiredo Gontijo, Marcos Horácio Pereira ... See all authors

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Abstract

In arthropods, hematophagy has arisen several times throughout evolution. This specialized feeding behavior offered a highly nutritious diet obtained during blood feeds. On the other hand, blood-sucking arthropods must overcome problems brought on by blood intake and digestion. Host blood complement acts on the bite site and is still active after ingestion, so complement activation is a potential threat to the host's skin feeding environment and to the arthropod gut enterocytes. During evolution, blood-sucking arthropods have selected, either in their saliva or gut, anticomplement molecules that inactivate host blood complement. This review presents an overview of the complement system and discusses the arthropod's salivary and gut anticomplement molecules studied to date, exploring their mechanism of action and other aspects related to the arthropod–host–pathogen interface. The possible therapeutic applications of arthropod's anticomplement molecules are also discussed.

RESEARCH

Open Access



Efficacy of lotilaner against myiasis caused by *Cochliomyia hominivorax* (Diptera: Calliphoridae) in naturally infested dogs

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Abstract

Background The New World screwworm fly, *Cochliomyia hominivorax*, is widely distributed across South America. This parasitic insect is a significant cause of primary myiasis in animals, including dogs. There is an urgent need for a rapid and efficient treatment to improve the recovery of affected animals. In the present study we evaluated the potential of lotilaner for the treatment of myiasis caused by *C. hominivorax* larvae in naturally infested dogs. Lotilaner belongs to the isoxazoline class of chemical compounds and is marketed as CredelioTM for use against ticks and fleas in dogs and cats.

Methods Eleven dogs with naturally acquired myiasis were enrolled in this study based on the severity of lesions and the number of identified larvae. All animals received a single oral administration of lotilaner at a minimum dose of 20.5 mg/kg body weight. After treatment, the number of expelled larvae, live or dead, was determined at 2, 6 and 24 h, and the larval expulsion rate, larvicidal effect and overall efficacy were calculated. After 24 h, the remaining larvae were removed, counted and identified. The lesions were cleaned, and palliative treatment was administered when necessary, according to the animal's health status.

Results All larvae were identified as *C. hominivorax*. The larval expulsion rate was 80.5% and 93.0% at 2 and 6 h post-treatment, respectively. Lotilaner showed an overall efficacy of 100% at 24 h post-treatment.

Conclusions Lotilaner demonstrated a rapid onset of action and a high efficacy against *C. hominivorax*. We therefore recommend lotilaner for the effective treatment of myiasis in dogs.

Keywords New World screwworm fly, Ectoparasites, Dogs, Myiasis, Control strategies

Research Paper

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Essential oils from *Ocimum basilicum* cultivars: analysis of their composition and determination of the effect of the major compounds on *Haemonchus contortus* eggs

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Abstract

The continuous use of synthetic anthelmintics against gastrointestinal nematodes (GINs) has resulted in the increased resistance, which is why alternative methods are being sought, such as the use of natural products. Plant essential oils (EOs) have been considered as potential products for the control of GINs. However, the chemical composition and, consequently, the biological activity of EOs vary in different plant cultivars. The aim of this study was to evaluate the anthelmintic activity of EOs from cultivars of *Ocimum basilicum* L. and that of their major constituents against *Haemonchus contortus*. The EOs from 16 cultivars as well as the pure compounds linalool, methyl chavicol, citral and eugenol were used in the assessment of the inhibition of *H. contortus* egg hatch. In addition, the composition of these cultivars was simulated using a combination of the two major compounds from each. The EOs from different cultivars showed mean Inhibition Concentration (IC₅₀) varying from 0.56 to 3.22 mg/mL. The cultivar with the highest egg-hatch inhibition, Neapolitano, is constituted mainly of linalool and methyl chavicol. Among the individual compounds tested, citral was the most effective (IC₅₀ 0.30 mg/mL). The best combination of compounds was obtained with 11% eugenol plus 64% linalool (IC₅₀ 0.44 mg/mL), simulating the Italian Largo Leaf (Richter) cultivar. We conclude that different cultivars of *O. basilicum* show different anthelmintic potential, with cultivars containing linalool and methyl chavicol being the most promising; and that citral or methyl chavicol isolated should also be considered for the development of new anthelmintic formulations.



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Research paper

Nemabiome metabarcoding reveals differences between gastrointestinal nematode species infecting co-grazed sheep and goats

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ABSTRACT

Our current understanding of differences in the epidemiology of gastrointestinal nematode (GIN) species in co-grazed sheep and goats is inadequate with inference to the development of sustainable control strategies. The next-generation metabarcoding sequencing method referred to as the 'nemabiome' allows some of these differences to be explored to describe the intensity of co-infecting GIN species. We applied this platform to study sheep and goats that were co-grazed on Guinea grass pasture in northeastern Brazil. Co-grazed goats and sheep were treated with a monopantel anthelmintic, then exposed to the same gastrointestinal nematode species. Overall, there were differences in the prevalence of GIN species identified in the sheep and goats; *Trichostrongylus colubriformis* and *Teladorsagia circumcincta* predominated in goat kids, while *Haemonchus contortus* predominated in adult does, ewes and lambs once burdens became re-established after anthelmintic treatment. Description of the pattern of re-infection following anthelmintic treatment was prevented by the unexpected poor efficacy of 2.5 mg/kg and 5 mg/kg, respectively, of monopantel against *O. columbianus* and *T. circumcincta* in lambs, and *T. circumcincta* adult does. Differences in drug efficacy between host age and species groups may be important when considering sustainable GIN control strategies for co-grazed animals. The aggregated FECs of the adult does and goat kids representing re-established GIN burdens, were higher than those of the co-grazed adult ewes and lambs. This implies that there are inherent differences in GIN species adaptation to the two naive small ruminant host species, and shows the need for better understanding of the factors giving rise to this situation associated with exposure to infective larvae and host responses. At the start of the study, the adult does were co-infected with several GIN species, with the highest intensity of *T. circumcincta*, contrasting with the situation in the adult ewes, in which *H. contortus* predominated. However, once burdens became re-established after treatment, *H. contortus* predominated in both adult does and ewes. This demonstrates the potential for host burdens of *H. contortus* to establish and predominate after anthelmintic treatment when burdens of co-infecting GIN species are low.

1. Introduction

Sheep and goats are the mainstay of both smallholder and larger-scale livestock agriculture throughout Asia, the middle-east, Africa and South America, where the two species are commonly co-managed on the same pastures. Despite their physical similarities, domestic sheep (*Ovis aries*) and goats (*Capra hircus*) have genetically different wild progenitors; based on mitochondrial DNA sequence analysis, sheep are

more closely related to cattle, buffalo and pigs than they are to goats (MacHugh and Bradley, 2001). The physiology of the two species is underpinned by different metabolic pathways, hence their nutritional requirements and responses to infectious disease challenge vary. However, understanding of the consequences of these differences on gastrointestinal nematode (GIN) infections in co-managed groups of sheep and goats is rudimentary.

In natural environments, goats feed mainly by browsing on shrubs

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Practices employed by veterinary practitioners for controlling canine gastrointestinal helminths and ectoparasites

Práticas realizadas por veterinários para controle de helmintos gastrintestinais e ectoparasitos de cães

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Abstract

The present study attempted to evaluate the practical experience and methods employed by Brazilian veterinary practitioners for control of parasites. Twenty-one questions were asked of 403 veterinary practitioners based in different climatic zones with reference to parasite epidemiology from the country. Administration of a combination of drugs at three-month intervals was the most common regime recommended for prophylaxis against gastrointestinal helminths, with a single treatment repeated after 15 days. Routine prophylaxis against dog ectoparasites was recommended by 82.4% veterinary practitioners, and 46.6% changed the drug compound used. Monthly prophylactic treatments for ectoparasites, using systemic, topical and/or collar-impregnated drugs, was recommended by 21.5% veterinary practitioners. Side-effects of ectoparasiticide-impregnated collars were suspected by 58% of the veterinary practitioners. Isoxazolines were the most frequently used chemical group to treat ectoparasites in dogs. Poor efficacy of fipronil in controlling ticks was suspected by 79.5% of the veterinary practitioners. The isoxazoline and combination of anthelmintic compounds are the most common drugs to prevent or treat ectoparasites and gastrointestinal nematodes, respectively. The suspect of the inefficacy of antiparasitic drugs is shared among the veterinary practitioners from part of Brazil. Guidelines are needed, specifically for the control of gastrointestinal helminths and ectoparasites in Brazilian dogs.

Keywords: Gastrointestinal nematodes, ectoparasites, dogs, antiparasitic drugs, control strategies.

Resumo

O presente estudo avaliou os métodos de controle empregados por médicos veterinários clínicos para o controle de parasitos de cães no Brasil. Vinte e uma perguntas foram feitas a 403 veterinários de diferentes regiões do país. O uso de associações de compostos ativos em intervalos de três meses foi o mais recomendado para profilaxia de helmintos gastrintestinais, repetido após 15 dias. A profilaxia de rotina contra ectoparasitos foi recomendada por 82,4% dos veterinários, e 46,6% mudam rotineiramente o composto indicado. Tratamentos profiláticos mensais para ectoparasitos, com produtos sistêmicos, tópicos e / ou impregnados com collar, foram recomendados por 21,5% dos veterinários. Os efeitos colaterais das coleiras impregnadas com ectoparasiticidas foram relatados por 58% dos médicos veterinários. As isoxazolininas foram o grupo químico mais utilizado para tratar ectoparasitos em cães. A baixa eficácia do fipronil no controle de carrapatos foi suspeitada por 79,5% dos médicos veterinários. As isoxazolininas e a associação de compostos anti-helmínticos são os medicamentos mais comuns para prevenir ou tratar ectoparasitos e nematoides gastrintestinais, respectivamente. A suspeita

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The gut anti-complement activity of *Aedes aegypti*: Investigating new ways to control the major human arboviruses vector in the Americas

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Abstract

Aedes aegypti is the main urban vector of dengue virus, chikungunya virus and Zika virus due to its great dispersal capacity and virus susceptibility. *A. aegypti* feed on plant-derived sugars but females need a blood meal for egg maturation. Haematophagous arthropods need to overcome host haemostasis and local immune reactions in order to take a blood meal. In this context, molecules present in the saliva and/or intestinal contents of these arthropods must contain inhibitors of the complement system (CS). CS salivary and/or intestinal inhibitors are crucial to protect gut cells of haematophagous arthropods against complement attack. The present work aimed to investigate the anti-complement activity of *A. aegypti* intestinal contents on the alternative, classical and lectin pathways of the human complement system. Here we show that *A. aegypti* gut contents inhibited the human classical and the lectin pathways but not the alternative pathway. The *A. aegypti* gut content has a serine protease able to specifically cleave and inactivate human C4, which is a novel mechanism for human complement inactivation in haematophagous arthropods. The gut of female *A. aegypti* was capable of capturing human serum factor H (a negative complement modulator), unlike males. C3 molecules in recently blood-fed female *A. aegypti* remain in their original state, being inactivated to iC3b soon after a blood feed. A transmission-blocking vaccine using these complement inhibitory proteins as antigens has the potential to interfere with the insect's survival, reproductive fitness and block their infection by the arboviruses they transmit to humans.

Keywords: *Aedes aegypti*; C4 cleavage; Classical pathway; Factor H; Gut; Human complement.

AVALIAÇÃO DE SUBSTÂNCIAS REPELENTES PARA CARRAPATOS

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RESUMO

Os carrapatos são ectoparasitos com importância médica e veterinária, se tornando um grande problema para os seus hospedeiros. O controle com o uso de substâncias carrapaticidas vem selecionando populações resistentes e na grande maioria não impede a transmissão de doenças. As substâncias repelentes são utilizadas e devem ser melhor exploradas ainda para controle e carrapatos e doenças transmitidas. Nesse capítulo apresentamos e discutimos os produtos sintéticos e naturais com comprovada ação repelente, os bioensaios para avaliação da ação repelente e as novas perspectivas para repelentes de origem natural.

Palavras-chave: produtos naturais, voláteis, repelente

EVALUATION OF TICK REPELLENT SUBSTANCES

SUMMARY

Ticks are ectoparasites with medical and veterinary importance, becoming a significant problem for their hosts. Control with the use of tick substances has been selecting resistant populations, and, for the most part, it does not prevent the transmission of diseases. Repellent substances are used and should be further explored to control ticks and tick-borne diseases. This chapter presents and discusses synthetic and natural products with proven repellent action, bioassays to evaluate the repellent effect, and new perspectives for repellents of natural origin.

Keywords: natural compound, volatile, repellent