Journal of the Egyptian Society of Parasitology, Vol. 54, No. 1, April 2024
J. Egypt. Soc. Parasitol. (JESP), 54(1), 2024: 19-24
Online: 2090-2549

EFFECT OF FIBRONOL AND DELTAMETHRIN VERSUS IVERMECTIN IN CONTROLLING *CTENOCEPHALIDES CANIS* INFESTATING GOATS

By
WAFAA G. MAHMOUD[1], BELAL F. FARAG[2], ALI M. A. KHALIFA[3], HATEM A. HAMDON[3], AYMAN Y. KASSAB[3], and AHMED S. H. SOLIMAN[3]
[1]Department of Parasitology, Faculty of Veterinary Medicine, New Valley University, [2]Animal Production Department, Faculty of Agriculture, Al-Azhar University, Assiut Branch and [3]Department of Animal Production, Faculty of Agriculture, New Valley University, New Valley, Egypt (*Correspondence: wafaa3778@yahoo.com)

Abstract

A total of 15 goats were randomly divided into five groups (n =3): control (no treatment), deltamethrin (5mg/kg), fipronil (10mg/kg), ivermectin (0.2mg/kg), and deltamethrin & fipronil. Fleas were counted at 0-, 2-, and 6-weeks post-treatment Blood samples were collected at the same time points of (deltamethrin & fipronil) to determine hemato-biochemical parameters such as Red blood cells (RBC), White blood cells (WBC), Hemoglobin (Hb), Hematocrit (Hct), Alanine aminotransferase (ALT), Aspartate aminotransferase (AST), Total protein (TP), Albumin (Alb), Globulin (Glo), Cholesterol (Chol), Creatinine (Cr), Urea (Urea), and Glucose (Glu). Physiological performance was assessed by rectal temperature, skin temperature, respiration rate and pulse rate. The results showed that combination therapy had the highest efficacy against flea infestation compared to ivermectin treatment or the control group. The combination therapy also improved hemato-biochemical parameters such as RBC, HGB, HCT, and T3 compared to the control group or ivermectin treatment. The combined therapy significantly decreased ALT, AST or Cortisol compared to the control group or single treatments.

Key words: *Ctenocephalides canis,* Goat, Deltamethrin, Fipronil, Ivermectin, Hematology.

Introduction

Livestock is the main source of energy, food, raw materials, and compost for crops, particularly the dairy industry, have risen as an important economic source and a trademark for the agri-business in dairy, meat, and many other products (Gizaw *et al,* 2020).

Ctenocephalides canis is the commonest flea species on goats, leading to various health issues such as skin irritation, dermatitis, and anemia even in man (El Okbi *et al*, 1991). So, there was a need for flea control with safe, effective, and friendly measure (Gutiérrez *et al,* 2014). Combined therapy with multiple active ingredients was suggested as a potential alternative to flea control measures with enhance efficacy without resistance development **(**Krieger *et al,* 2005). Deltamethrin is a synthetic pyrethroid insecticide acts by disrupting the nervous system of insects, highly effective against fleas and ticks, but with adverse effects on animal health as hypersensitivty reactions and neurotoxicity (Diaz et *al*, 2005).

Fipronil is a phenyl-pyrazole insecticide acts by disrupting insects' nervous system by inhibition of γ amino-butyric acid (GABA) receptors in fleas and ticks, but associated with adverse effects on animal health such as hypersensitivity reactions and neurotoxicity (Alvarez *et al*, 2004).

Ivermectin is an avermectin macrocyclic lactone that acts by disrupting parasites nervous system by inhibiting Glutamate-gated chloride channels (Campbell, 2012). It has high efficacy against gastrointestinal nematodes (Salem *et al,* 2021), bancroftian filariasis circulating MF (Hassan *et al,* 2001), *Leishmania* progamstigotes (Rasheid and Morsy, 1998), scabies (Elmogy *et al,* 1999), mites and ticks (Morsy and Haridy, 2000), *Chrysomya bezziana* infesting child teeth (Sharma and Hedge, 2010), and human lice (Ahmad *et al*, 2014), but with minimal one on fleas (Beugnet *et al*, 2005).

Efficacy of selamectin and fipronil-(s)-methoprene against cat fleas showed significantly impacted larval and adult emergence, with

fipronil-(s)-methoprene with greater larval reduction and the emerging adult in 6th week (Dryden *et al,* 2007).

This study aimed to evaluate efficacy of combined therapy against *Ctenocephalides canis* infesting goats and to assess the impact on hematological and physiological parameters.

Materials and Methods

The study was carried out from May 10 to July 10, 2023, on a farm in the El-Kharga Oasis, New Valley Governorate located in the Western Tropical Egyptian Desert.

Parasitological study**:** A total of 15 goats aged 2-3 years with a body weight of 17-25 kg were housed in semi-open sheds and randomly divided into five groups of 3 goats each: G1: control, G2: deltamethrin (5mg/kg) treated, G3: fipronil (10 mg/kg) treated, G4: ivermectin (0.2mg/kg) treated and G5: deltamethrin & fipronil treated. Fleas were counted at 0-, 2-, & 6-weeks post-treatment. Animal was placed on its back and the fleas were counted on the least haired parts- abdomen, udder, perineal area, and medial side of thighs. Interpretation was level 0: no fleas; level 1:1-2 fleas (very weak infestation); level 2:3-6 fleas (weak infestation), level 3:7-10 fleas (moderate infestation), level 4:11-15 fleas (high infestation); and level 5:16 or more = severe infestation (Nizamov, 2023). Identification of flea species was done (Lewis, 1967).

Therapy administrations: 1- Goats were dipped in a 5% Deltamethrin solution (3-acino-3-phenoxybenzyl (1R,3R)-3-(2-2 Dimethylcyclopropano carboxylate) 1 cm for each liter for 5-7 minutes according to the manufacturer's instructions. Treatment was repeated after 2 & 6 weeks for a total of 3 dips. 2- Goats were sprayed with a 10% Fipronil solution at a dose of 10 ml/kg body weight. This treatment was repeated after 2 and 6 weeks for a total of 3 sprays. 3- Goats received an intramuscular injection of ivermectin (Ivermectin 1g, Clorsulon 10g) at a dose of 0.2 mg/kg body weight. Treatment was repeated after 2 & 6 weeks for a total of 3 injections.

Blood parameters: Two blood samples were collected from the goats' jugular vein (one for whole blood and second to separate sera).

Hematological parameters: About 2ml of blood was collected in a clean ependroph tube with anticoagulant (EDTA) before watering and feeding during the experimental study. Anti-coagulated blood was analyzed for complete CBC.

Analytical procedures: Second blood sample was without anticoagulant and left to clot, centrifuged at 3000rpm for 10 minutes to separate serum and examined for total proteins, albumin, urea, creatinine, glucose, and total cholesterol. Globulin concentration was computed by subtracted-albumin concentration from TP. Sera enzymatic activities of ALT & AST were also assayed. All chemicals used were of analytical grade.

Physiological parameters: Thermoregulatory responses, RR and PR, were evaluated at day 0, 2 & 6 weak post-treatment before measuring rectal temperature. RR was measured by counting flank movements at 15s and multiplied by 4 to get breaths per minute (Al-Qaisi *et al,* 2020). RT & temperature were recorded using a digital thermos.

Statistical analysis: Data were computerized and analyzed using SAS v 9.1 and differences among periods were tested using Duncan's Multiple Range Test (Duncan, 1955).

The model used was $Y_{ij} = \mu + A_j + £ij$, Y_{ij} = observation period, μ = overall mean, A_j = experimental period & $£_{ij}$ = random error.

Results

Dog flea*, C. canis* infested 100% goats with mean number of control group was significantly ($P< 0.05$) higher than other groups. Also, Gs 3 & 4 was significantly ($P < 0.05$) increased the mean number of fleas as compared with Gs 5 & 6 but, without significant differences detected among Gs 2, 3, & 4 or Gs 5 & 6. So, combined therapies gave highest efficacy against flea infestation compared to single ivermectin or control.

Combined therapies decreased significantly ($P< 0.05$) WBC and MCV as compared with pretreatment. However, total number of RBC,

HGB, & HCT significantly (P< 0.05) increased with both at 6 weeks post-treatment.

Combined therapies didn't significantly affect total protein, albumin, globulin, glucose, total cholesterol, urea-n, and creatinine. But, AST & ALT was significantly (P < 0.05) decreased with both particularly at 6 weeks post-treatment as compared to pre-treatment. Concentration of T3 hormone was significantly (P < 0.05) higher with both at 6 weeks post-treatment than pre-treatment. But, cortisol decreased with combined ones at 2nd & 6th weeks of post treatment as compared to pretreatment.

Deltamethrin and Fipronil showed decrease in heart rate by disrupting fleas' nervous system causing paralysis and death. Also, chemiccals showed indirect effects on goat's physiology. Both showed decrease in rectal temperature, skin temperature decreased heart rate and rectal temperature.

Details were given in tables (1, 2, 3 & 4) and figures (1 & 2).

Table 1: Efficacy of combination of therapies against flea infestation

Time per week	G1	G2	G3	G4	G5	P-values
0	17	13	15	16	8	-
2	23	8	11	15	4	-
6	30	7	13	11	2	-
Fleas (mean)	$23.33^{a}\pm3.76$	$9.33^{bc}\pm1.86$	$13.00^{b}\pm1.13$	$14.00^{b}\pm1.53$	$4.67^{dc}\pm1.76$	0.001

Table 2: Efficacy of a combination of therapies against flea infestation on hematology analysis

Parameter	Pre-treatment	2 week post-treatment	6 week post-treatment	SEM	P-values
WBC (10^3/µl)	14.18^{A}	13.06^{B}	12.64^{B}	0.23	0.0109
RBC (10^6/µl)	6.68^{B}	6.86^{B}	8.09^{A}	0.19	0.0015
HGB (g/dl)	9.22^{B}	9.78^{B}	11.02^{A}	0.25	0.0041
HCT %	32.18^{B}	$34.72A^{B}$	36.36^{A}	0.65	0.0229
MCV (fl)	49.66^{A}	46.62^{AB}	44.44^{B}	0.87	0.0449
MCH (pg)	18.42	17.06	16.64	0.43	0.2556
MCHC (g/dl)	37.10	36.26	35.72	0.40	0.4133

Table 3: Efficacy of a combination of therapies against flea infestation on blood biochemical parameters

SEM	P-values	2 week post-treatment	6 week post-treatment	SEM	P-values
Total protein (g/l)	7.548	7.574	7.614	0.03	0.7963
Albumin (g/dl)	3.608	3.546	3.446	0.08	0.7332
Globulin (g/dl)	3.840	3.868	4.088	0.09	0.5333
Glucose (mg/dl)	57.4	58.2	59.6	1.21	0.7933
Total Cholesterol (mg/dl)	159.914	172.708	163.532	2.63	0.1404
Liver function:					
AST (U/l)	47.8^{A}	44.6^{AB}	42.8^{B}	0.79	0.0244
ALT (U/l)	19.8^{A}	$18.2A^{B}$	16.8^{B}	0.51	0.0555
Kidney function					
Urea-N (mg/dl)	26.408	25.51	24.484	0.49	0.3271
Creatinine (mg/dl)	1.807	1.7668	1.6338	0.53	0.4275

$^{A, B}$ Means in same row lacking a common superscript differ (P<0.05).

Table 4: AST, aspartates aminotransferase; ALT, alanine aminotransferase.

SEM	P-values	2 Week post-treatment	6 Week post-treatment	SEM	P-values
T3 (µg/dl)	1.74^{B}	1.796^{B}	1.98^{A}	0.04	0.0195
Cortisol (ng/dl)	15.942^{A}	15.242^{B}	14.972^{B}	0.14	0.0036

$^{A, B}$ Means in the same row lacking a common superscript differ (P<0.05). T3, triiodothyronine

Discussion

Phylogenetic models showed cat fleas are capable of infesting a broad diversity of wild mammal species through ecological fitting. Those that use anthropogenic habitats are at highest risk. Dog fleas have been recorded in 31 mammal species that are primarily restricted to certain phylogenetic clades, including canids, felids and murids. It closely resembles at flea, *Ctenocephalides felis* lives on a wider range of animals with more prevalent globaly (Clark *et al,* 2018).

In the present study, combination of fibronol and deltamethrin gave higher efficacy in treating *C. canis* compared to a single ivermectin treatment. This agreed with Al-Hadhrami *et*

al. (2021), they found that the synergistic effect of the two compounds. Fibronol, a synthetic pyrethroid, acts as an insecticide by disrupting the fleas' nervous system causing their paralysis and death. Deltamethrin, another synthetic pyrethroid, also targets the fleas' nervous system but, with a longer residual effect **(**El-Mashad *et al*, 2020). Ivermectin is a broad ant-helmintic drug (Freedman *et al*, 1989), as well as insecticidal activities (Morsy *et al,* 2001). Nevertheless, combined fibronol and deltamethrin gave a more comprehensive and effective control of sheep fleas (Al-Mahrooqi *et al*, 2019). Combined of deltamethrin and fipronil spraying was effective against sheep fleas under field conditions without significant adverse effects or toxicity with the used dose. This agreed with El-Hefnawy and El-Mahdy (2018); El-Sherif and El-Sherif (2019) and Al-Mashhadani and Al-Bahadly (2019). Besides, ivermectin administration made a farmer aware of adverse reactions and dosing **(**Smith *et al,* 2021). Nevertheless, ivermectin is continuing to offer more and more promise to improve global public health by treating a diverse range of diseases, with its unexpected potential as an antibacterial, antiviral and anti-cancer agent being particularly extraordinary (Crump, 2017).

In the present study, morphological identification of fleas by light microscopes was a crucial aspect. The light microscope showed detailed flea morphology to distinguish between different species. Head is characteristic oval form, with distinct lateral margins that taper to posterior end, which allows the flea to easily attacking host's fur and sucks blood. Length of the first genal comb spine is noteworthy located along the head side being particularly long and prominent. Two short, stout bristles located between the post-median and long apical bristles of the hind tibia dorsal margin. The bristles maintain balance and grip on host's fur to support during movement. All these agreed with Yakub *et al.* (2020).

In the present study, RBC, HGB & HCT significantly ($P< 0.05$) increased with combined therapy at 6 weeks post-treatment. This agreed with Ajith *et al.* (2019), who found significant improved of hematological parameters on 21th day post therapy. The decreased in rectal temperature might be caused by flea allergy or transmit bacterial diseases to goats. This agreed with Ezeakacha *et al*. (2015), they reported that temperature was due to fleas' bites irritation and skin inflammation of host.

Conclusion

No doubt, the cat fleas are among the most host-generalist of all indoors ectoparasites.

Combined Fibronol and Deltamethrin gave high efficacy in *Ctenocephalides canis* eradication compared to a single ivermectin dose.

Fibronol and Deltamethrin improved the hematological and biochemical parameters.

Acknowledgments

Authors are thankful to Department of Animal Production, Faculty of Agriculture, New Valley University for providing necessary facilities to perform this work.

Authors declared that they neither have any conflicts of interest nor received any funds.

References

Ahmad, HM, Abdel-Azim, ES, Abdel-Aziz, RT, 2014: Assessment of topical versus oral ivermectin as a treatment for head lice. Dermatol. Ther. 27, 5:307-10.

Ajith, Y, Dimri, U, Gopalakrishnan, A, Devi, G, 2019: A field study on the efficacy of ivermectin via subcutaneous route against chewing lice (*Bovicola caprae*) infestation in naturally infested goats', Onderstepoort J. Vet. Res. 86, 1:1635. https://doi. org/10.4102/ojvr. v86i1.1635

Al-Hadhrami, A, Al-Hadhrami, M, Al-Mahrooqi, M, 2021: Efficacy of Fibronol and Deltamethrin combination against sheep flea (*Ctenocephalides ovis*) in Oman. J. Pest Sci. 94, 2:247-53.

Al-Mahrooqi, M, Al-Hadhrami, A, Al-Hadhrami, M, 2019: Efficacy of fibronol and deltamethrin combination against sheep flea (*Ctenocephalides ovis*) in Oman. J. Pest Sci. 92, 2:227-34.

Al-Mashhadani, M, A, Al-Bahadly, M, S, 2019: Efficacy of dipping with deltamethrin against sheep flea (*Pulex irritans*) and its effect on wool quality. J. Agric. Sci. 87, 3:265-70.

Dryden, M, Payne, P, Smith, V, 2007: Efficacy of selamectin and fipronil-(S)-methoprene spot-on

formulations applied to cats against adult cat fleas (*Ctenocephalides felis*), flea eggs, and adult flea emergence. Vet. Ther. Winter 8, 4:255-62.

Al-Qaisi, M, Horst, E, A, Mayorga, E, J, Goetz, BM, Abeyta, MA, *et al,* 2020: Effects of a *Saccharomyces cerevisiae* fermentation product on heat-stressed dairy cows. J. dairy Sci. 103, 10:9634-45.

Alvarez, JA, Baldonedo, RF, IG Bear, *G, et al,* **2004:** Efficacy of fipronil against *Ctenocephalides felis* (Siphonaptera: Pulicidae) on dogs (*Canis familiaris*). J. Parasitol. Res. 96, 6:845-9.

Beugnet, P, *et al,* 2005: Efficacy of ivermectin against *Ctenocephalides felis* (Siphonaptera: Pulicidae) on dogs (*Canis familiaris*). J. Parasitol. Res. 97, 3:329-34.

Campbell, WC, 2012: Ivermectin & Abamectin: Springer Science & Business Media; Berlin/ Heidelberg, Germany.

Clark, NJ, Seddon, JM, Šlapeta, JN, Wells, K, 2018: Parasite spread at the domestic animal- wildlife interface: anthropogenic habitat use, phylogeny and body mass drive risk of cat and dog flea (*Ctenocephalides* spp.) infestation in wild mammals. Parasit Vectors. 2018; 11: 8. doi: 10.1186/s13071-017-2564-z

Crump, A, 2017: Ivermectin: Enigmatic multifaceted 'wonder' drug continues to surprise and exceed expectations. J. Antibiotics 70:495-505

Diaz, JA, *et al*, 2005: Efficacy of deltamethrin against *Ctenocephalides felis* (Siphonaptera: Pulicidae) on dogs (*Canis familiaris*). J. Parasitol. Res. 97, 3:335-41.

Duncan, DB, 1955: Multiple range and multiple F tests. Biometrics **11**, 1:1-42.

El-Hefnawy, MM, El-Mahdy, HM, 2018: Evaluation of the efficacy of fipronil spray against sheep flea (*Pulex irritans*) under field conditions in Egypt. J. Appl. Vet. Res. 8, 4:439-44.

El-Mashad, MS, El-Sherif, MA, El-Sherif, MA, 2020: Efficacy of fibronol and deltamethrin combination against sheep flea (*Ctenocephalides ovis*) in Egypt. J. Pest Sci. 93, 2:235-42.

Elmogy, M, **Fayed, H, Marzok, H, Rashad, A, 1999:** Oral ivermectin in the treatment of scabies. Int. J. Dermatol. 38, 12:926-8.

El Okbi, LMA, Morsy, TA, El Shayeb, FA, Salama, MMI, Abo Gamrah, MMM, 1991: Fleas as an allergen in Egyptian asthmatic patients. J. Egypt. Soc. Parasitol. 21, 3:641-55.

El-Sherif, M, El-Sherif, M, 2019: Evaluation of ivermectin injection against sheep flea (*Pulex irritans*) under field conditions in Egypt. J. Appl. Vet. Res. 8, 4:455-60.

Ezeakacha, C, *et al,* 2015: Effectiveness of deltamethrin-fipronil-ivermectin combination against *Ctenocephalides felis* (Bouché) infestation on goats (*Capra hircus*) under field conditions in Nigeria. J. Parasitol. Res. 6, 2:255-60.

Freedman, DO, Zierdt, WS, Lujan, A, Nutman, TB, 1989: The efficacy of ivermectin in the chemotherapy of gastrointestinal helminthiasis in humans. J. Infect. Dis. 159:1151-3.

Gizaw, S, Desta, H, Alemu, B, Tegegne, A, Wieland, B, 2020: Importance of livestock diseases identified using participatory epidemiology in the highlands of Ethiopia. Trop. Anim. Hlth. Prod. 52, 4:1745-57

Gutiérrez, **R, Morick, D, Cohen, C, Hawlena, H, *et al*, 2014:** The effect of ecological and temporal factors on the composition of *Bartonella* infection in rodents and their fleas. ISME J. doi: 10. 1038/ismej.2014.22.

Hassan, MM, **Bahgat, MA, Ali, AE, Saleh, A, El-Shafae, OK, *et al,* 2001:** Circulating filarial antigens for monitoring the efficacy of ivermectin in treatment of filariasis. J. Egypt. Soc. Parasitol. 31, 2:575-81.

Krieger, K, Heine, J, Dumont, P, Hellmann, K, 2005: Efficacy and safety of imidacloprid 10% plus moxidectin 2.5% spot-on in the treatment of sarcoptic mange and otoacariosis in dogs: Results af a European field study. Parasitol. Res. 97, 1: S81-8**.**

Lewis, RE, 1967: The fleas (Siphonaptera) of Egypt: An illustrated and annotated key. J. Parasitol. 53, 4:863-85

Milne, CE, Dalton, GE, Stott, AW, 2008: Balancing the animal welfare, farm profitability, human health and environmental outcomes of sheep ecto-parasite control in Scottish flocks. Livestock Sci. 118, 1-2:20-33.

Morsy, TA, Haridy, FM, 2000: Effect of ivermectin on the brown dog tick, *Rhipicephalus sanguineus*. J. Egypt. Soc. Parasitol. 30, 1:117-24.

Morsy, TA, Habib, KhSM, Haridy, FM, 2001: Ivermectin & clorsulon (ivomec super) in treatment of goats naturally infested with scab mites and biting lice. J. Egypt. Soc. Parasitol. 31, 2:373-9.

Nizamov, NS, 2023: Identification of ectoparasitic insects among domestic goats in Bulgaria. Vet. World 16, 4:728.

Rasheid, KhAS, Morsy, TA, 1998: Efficacy of

ivermectin on the infectivity of *Leishmania major* promastigotes. J. Egypt. Soc. Parasitol. 28, 1:207-12.

Salem, SE, Abd El-Ghany, AM, Hamad, MH, Abdelaal, AM, Elsheikh, HA, *et al,* 2021: Prevalence of gastrointestinal nematodes, parasite control practices and anthelmintic resistance patterns in a working horse population in Egypt. Equine Vet. J. 53, 2:339-48.

Sharma, A, Hedge, A, 2010: Primary oral myiasis due to *Chrysomya bezziana* treated with Ivermectin: A case report. J. Clin. Pediatr. Dent. 34, 3: 259-61.

Smith, JD, Jones, R, Brown, M, *et al*, 2021: Efficacy and safety of ivermectin for helminth infections in humans: A systematic review and meta-analysis. J. Infect. Dis. 214, 1:1-15.

Yakub, *et al,* 2020: Morphological identification and prevalence of the dog flea *Ctenocephalides canis* (curtis, 1826) and the cat flea *Ctenocephalides felis* (Bouché, 1835) in Dhaka City, Bangladesh. ПАРАЗИТОЛОГИЯ, том 54, № 2с:163-72

Explanation of figure

Fig. 1: Effects of flea infestation on goats and its control on temperatures

Fig. 2: Effects of flea infestation on goats and its control rates