THE EFFICACY OF DIFFERENT ACARICIDES AGAINST THE HARD TICK *DERMACENTOR MARGINATUS* ON INFESTED SHEEP

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Abstract

The aim of the present study was to evaluate the efficacy of four acaricids, from different pharmacologic groups, in control of tick infestation in sheep. Additionally, clinical specific aspects of the infestations were registered. The study was carried out during of March – April 2012, in a southern area of Romania (Colibasi village, Giurgiu County). The therapeutic efficacy of four different acaricides: Deltamethrin (pirethroid), Amitraz (formamidine), Diazinon (organophosphate), and Ivermectine (macrocyclic lactone) on natural tick infestation in sheep was evaluated. The animals (n=40) were divided into four groups (n=10/group) corresponding to the four used drugs. The first three products were used by dipping, in concentration of 0.05% for Delthametrin, 0.05% for Amitraz, and 0.04% for Diazinon. Ivermectine (1%) was subcutaneously injected (0.2 mg/kg). The animals were examined before and after treatment at 3, 5, 7, 14 and 21 days. The number of ticks per animal, the main elective body regions for tick attachment, and the associated lesions, were also registered. A total number of 1054 ticks (938 females, 116 males) were collected from infested sheep, all belonging to the Dermacentor marginatus species. The body areas highly infested were, in order of prevalence: the substernal area (63.6%), sides of the neck (14.2%) and the tail (7.1%). Lesions associated with tick infestation consisted of local irritations and inflammations, nodular dermatitis and micro abscesses. The best acaricidal efficacy was registered for Delthametrin (79.5%, at 3 days and 100% at 5 days p.t.) and Amitraz (90.4%, 96.4% and 100% at 3, 5 and 7 days p.t. respectively); both acaricids preserved full protection at 14 and 21 days after treatment. Ivermectin reached maximum efficacy at 7 days p.t. (92%), afterwards dropping at 79.8% at 21 days p.t..

Key words: *acaricids, Dermacentor marginatus, efficacy, infestation, sheep.*

INTRODUCTION

Ticks (Acari: Ixodidae) are ectoparasites with an important direct pathogenic role, but as well as vectors for many pathogens in human and animals (Estrada-Peňa et al., 2004). Tick infestation presents a serious challenge to farmers of ruminants in both developed and developing countries (Jongejan, 1999).

Ticks harm the hosts both directly and indirectly. Direct harm results from blood loss, tick burden as well as toxicoses. The bites can be injurious and cause severe hide damage including abscessation and can provide a route for secondary infection. Blood loss and reduction in weight gain resulting from tick feeding are among major factors that affect ruminant production in different parts of the world (Daynes et al., 1984).

Indirectly, ticks can cause economic loss because they play an important role as vectors of a wide range of pathogens to humans and domestic animals (Ioniță, 2004; Mitrea, 2011). Some arbovirosis, rickettsiosis, anaplasmosis, tularemiosis, babesiosis and theileriosis are pathogenic entities with great economic impact for animal production and some of them with zoonotic risks, too (Holdsworth et al., 2006).

Tick control is primarily based on the use of acaricides applied to animals on a systematic schedule, according to the local conditions. Various acaricides, including arsenic and DDT between the 1940s and 1970s, organophosphates between the 1980s and 1990s, and pyrethroids and amitraz from the mid 1980s to present time, have been used to control this economically important pest (Mitrea, 2011).

The major constraint of chemical treatment is selection for acaricide resistant tick strains. Inappropriate acaricide use (Bianchi et al., 2003) with incorrect concentrations probably contributes to the development of resistance, which leads to tick-control program failures (Pegram et al., 2000).

Hence, for an effective chemical control strategy, periodic monitoring of effectiveness is essential, especially in order to offer updated information on the efficacy of the different acaricides available on the market toward to provide an effective control against tick infestations on animals.

Therefore, the objective of the present study was to evaluate the efficacy of four acaricides, belonging to different pharmacological groups, in controlling naturally infestations with ixodide ticks of small ruminants. In the same time, the associated clinical aspects of tick infestations in animals were registered.

MATERIALS AND METHODS

The research was carried in a southern area of Romania (around Colibasi village, Giurgiu county), located between two rivers (Arges and Sabar). The climatic conditions (annual medium precipitations = 400-500 mm/m^2, medium temperature = 11ºC), local flora and fauna are favorable to the development of different species of hard ticks (Mitrea and Ionita, 2004).

The study was conducted during of March - April 2012 and included a number of 40 small ruminants (4 goats and 36 sheep - 34 females and 2 males), randomly assigned into four groups (A, B, C, D).
The animals, hybrids breeding in the area, with medium age of 2.08 years for goats and 5.3 years for sheep, identified with ear tags are breeds in extensive system, in population households.
The animals have been used pasture with approximately one month before starting the treatment, and they were continuing grazing also after they have been treated. No other treatments were applied.
The infestation degree of the animals studied was established by observing the ticks on the body of each animal.
Ticks were carefully collected from animals using forceps to ensure minimal mouthpart damage. Specimens were preserved in 70% ethyl alcohol, labeled, and were brought to the Parasitology Laboratory of Faculty of Veterinary Medicine, Bucharest, for taxonomic identification, using specific keys (Estrada- Pena et al., 2004).
The animals were clinically evaluated and various body parts of the infested animals have been examined. Subsequently, the animals were categorized as following: noninfested (no ticks on the body), low infested (mild) (1-20 ticks per animal), moderate infested (21-50 ticks per animal) and massively infested (over 50 ticks) (Teglas et al., 2005). The last three categories (mild, moderate, and high) were considered as "infestation."
Additionally, the associated lesions of the presence of ticks on animals were registered.
Group A, composed of 9 sheep and a goat, was treated with Ivermectine (IVM) 1% (Evomec – FarmaVet - Pasteur Institute) subcutaneous injections of 0.2 mg/kg, in a single dose. Group B, including 9 sheep (one male and 8 females) and a goat, was treated with Delthametrin (DMT) (Butox 50 – Intervet BSD) through bathing, in the concentration of 0.05%. Group C, including 9 sheep (2 males and 7 females) and a goat, was treated with Diazinon (DZN) (Diazinol – FarmaVet - Pasteur Institut) through bathing, in the concentration of 0.04%. Group D, comprised of 10 sheep, was treated with Amitraz (AMZ) (Taktic – Intervet BSD) through bathing, in the concentration of 0.05% (Crivineanu, 2008).
For bathing of each group, 60 liters of solution were used (approximately 6 liters for every sheep and 2 liters for goat).
After a single treatment with either of the above mentioned acaricides, the animals were examined for the presence of ticks on the body. The data are expressed as post-treatment tick burden on days 0, 3, 5, 7, 14 and 21.

The data collected were processed in Microsoft Office Excel 2007 program. The algorithm used to calculate the acaricide efficacy was:

$$\% \text{ Efficacy} = N_0 - N/ N_0 * 100,$$

where N_0 is the number of ticks before treatment and N is the number of ticks after treatment (Holdsworth et al., 2006).

RESULTS AND DISCUSSIONS

Dermacentor marginatus was the only tick species identified on the examined animals. A total of 1054 ticks were collected; of them, 938 were females and 116 males.

The overall tick infestation prevalence was 97.5% (39/40). The infestation degree was: low infested 64.1% (25/39), moderately infested 33.33% (13/39), and massive infested 2.56% (1/39).

The data regarding the parasitism dynamic intensity, for each lot after treatment are presented in Table 1.

In some subjects from group A, certain adverse reactions were noticed after 5-10 seconds of subcutaneously injected Ivermectine and persisted for about 45 seconds. Clinical signs consisted of bruxism, vaccilation, retropulsion, emprostotonus and circle movements. These aspects can incriminate the excipient of the product that produced an irritative reaction to the animals.

The highest intensity of the parasitism (56 ticks on a skin area with a diameter of 10 cm^2, in the neck region) was registered on an animal from group C, associated with obvious lesions like: thickened, low elasticity, hairless and pigmented skin.

Animals from group D presented the lowest degree of infestation, with a total number of 95 ticks collected.

Various body sites were categorized based on tick attachment preference on the infested animals: the substernal region (63.6%) was primary site of attachment, followed by neck region (14.2%), tail region (7.1%), internal side of the thigh (6.7%), legs (5.9%), and perineal region (2.5%) (Figure 1).

Table 1. **The ixodide tick infestation intensity on the four groups before and after treatment**

Day of examination	**Number of ticks**			
	Group A- Ivermectine	**Group B- Delthametrin**	**Group C- Diazinon**	**Group D- Amitraz**
Day of treatment	189	215	255	84
3rd day after treatment	104	44	43	8
5th day after treatment	35	0	7	3
7th day after treatment	15	0	0	0
14th day after treatment	12	0	8	0
21st day after treatment.	26	0	21	0
Total ticks	**381**	**259**	**334**	**95**

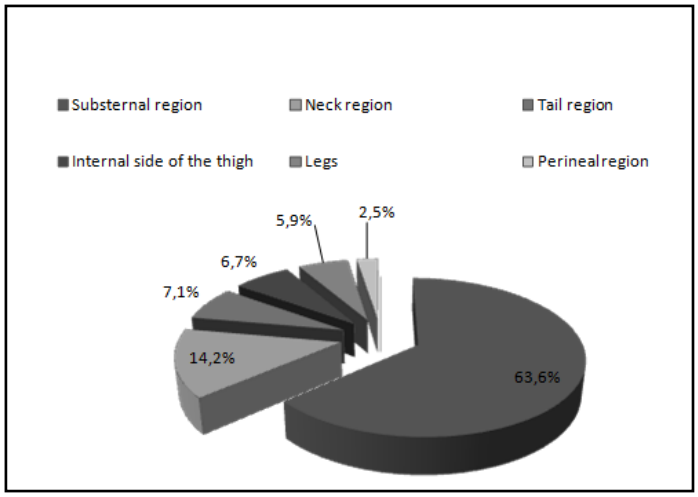

Figure 1.**The distribution of ticks according to their attachment preferences on the animal body** (in percentages)

Data regarding the efficacy of the acaricides used, expressed as percentage, at 3, 5, 7, 14 and 21 days post treatment, are presented in Table 2.

Table 2. **The efficacy dynamics of acaricides in relation to the day of examination**

Post-treatment	**Group A-Ivermectine**	**Group B-Delthametrin**	**Group C-Diazinon**	**Group D-Amtiraz**
3rd day after treatment	72,7%	79,5%	87,2%	90,4%
5th day after treatment	91%	100%	98%	96,4%
7th day after treatment	92%	100%	100%	100%
14th day after treatment	91,8%	100%	98%	100%
21th day after treatment	79,8%	100%	93,7%	100%

The control efficacy in terms of percent reduction in tick number decreased significantly at 7 days post-treatment, for all the four acaricides used (Figure 3).

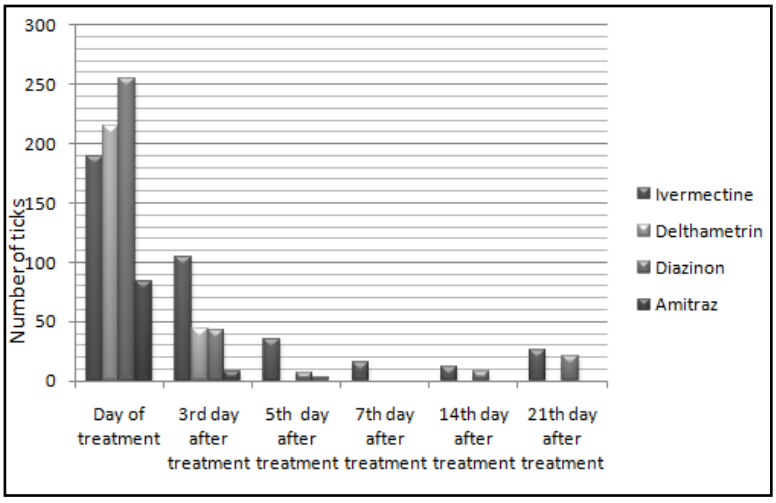

Figure 3. **Dynamics of the efficacy of the four acaricides**

In the IVM-treated group, the maximum reduction in number of ticks was found from days 5 to 7, until day 14, thereafter the tick infestation level started to increase. Therefore, IVM was not found to be effective in controlling the tick burden after 21 days post-treatment.

In the DTM-treated group, reduction in the number of ticks was significant higher, even from day 5 post treatment, being found effective even after 21 days post-treatment.
A similar, very good, efficacy was registered in the AMZ-treated group at 7 days post treatment, which has been maintained also at 21 days p.t.
For the DZN-group, the maximum reduction was obtained at 7 days p.t., however, at 14 and 21 days after the treatment the efficacy was lower.
Hence, the in vivo efficacy trials of DTM, AMZ, DZN (by bathing) and IVM (injectable) revealed better results for deltamethrin and amitraz.
The results obtained in the present study are in according with those of other authors. In a study carried out in Pakistan on 360 adult goats, the animals were submitted to treatments with pour-on Ivermectine and Cypermethrin 5% (other piretroid). The study revealed that Ivermectine reached maximum efficacy in the day 5 and 10 after treatment and continued until the 15th day. On the other hand, the group treated with Cypermethrin presented positive effects between day 1 and 5 of treatment, lasting over the 15th day. All substances used as bathing and as injections have better time coverage than substances used orally against endo- and ectoparasites (Sajid et al., 2011).
As lesions associated with tick infestations and their consequences, the following were registered: local swelling, followed by hypersensiti-vity reactions (type 1 and 4- due to foreign proteins found in the tick saliva), which manifest as local prurit (Coman, 2004); group stress; granuloma at the feeding site, which healed as a scar and lead to skin depreciation (Figure 2. A); alopecia on considerable areas with waistcoat depreciation (Figure 2 B); wet eczemas (Figure 2 C).
Other adverse effects, like septic complications, intoxications due to the anticoagulant substances secreted by the tick through its saliva and tick paralysis were reported in other studies (Barre et al., 2008; Sajid et al., 2011).

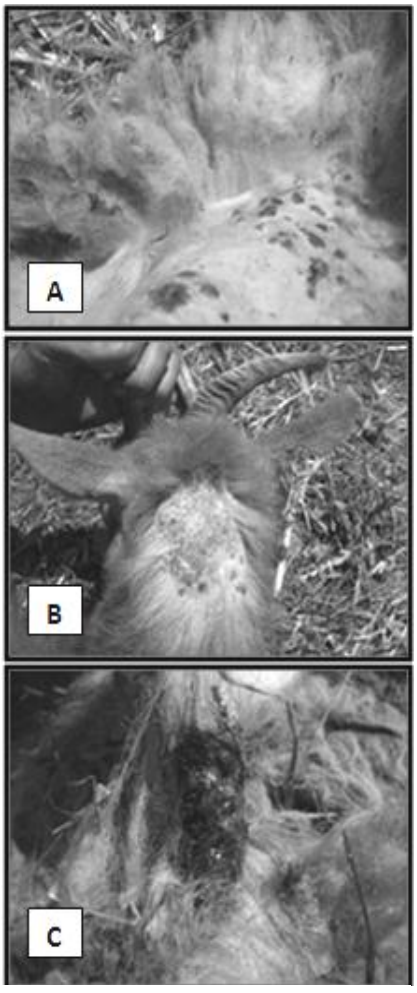

Figure 2. **Lesions associated with tick infestations**: A. healing phase granulomas; B: alopecia in the neck region; C: tail eczema

CONCLUSIONS

This study provides data on the efficacy of four different acaricides against *Dermacentor marginatus* infestation on small ruminants, revealing a maximum efficacy (100%) at 5 days after treatment for delthametrin and at 7 days after treatment for amitraz and diazinon. The therapeutic efficacy and protection against reinfestation was registered even at 21 days after treatment, when the last clinical examination was carried out.

These findings will help to promote an effective control of tick infestations on animals, based on a proper usage of the acaricides and on appropriate rotation sachems in order to avoid developing of chemoresistance.

REFERENCES

Barré N., Li A.Y., Miller R.J, Gaïa H, Delathière JM, Davey RB, George JE., 2008. In vitro and in vivo evaluation of deltamethrin and amitraz mixtures for the control of *Rhipi-cephalus microplus* (Acari: Ixodidae) in New Caledonia. Vet Parasitol. 155(1-2):110-119.

Bianchi, MW., Barre´ N., Messad S., 2003. Factors related to cattle infestation level and resistance to acaricides in *Boophilus microplus* tick populations in New Caledonia. Vet. Parasitol. 112, 75–89.

Coman S., 2004. Bolile parazitare la animalele domestice, Ed. 'Romania de Maine', Bucuresti.

Crivineanu M., 2008. Farmacologie veterinară, Editura Printech, Bucuresti.

Estrada-Pena A, Bouattour A, Camicas J-L, Walker AR, 2004. Ticks of domestic animals in the Mediterranean region: a guide to identification of species. University of Zaragoza, Spain.

Holdsworth PA, Kemp D, Green P, Peter RJ, De Bruin C, Jonsson NN, Letonja T, Rehbein S, Vercruysse J., 2006. W.AAVP, guidelines for evaluating the efficacy of acaricides against ticks on ruminants. Vet Parasitol.136(1):29-43.

Ionită Mariana, 2004. Cercetari privind ecologia familiei Ixodidae in unele zone ubcarpatice; aspecte epidemiologice ale parazitozelor ce pot fi transmise de acestea. Teza de doctorat, USAMV Bucuresti.

Jongejan F, Uilenberg G, 2004. The global importance of ticks. Parasitol 129:S3–S14.

Mitrea I. L., 2011. Parazitologie si boli parazitare la animale, Editura Ceres, București.

Mitrea I.L., M.Ioniță, 2004. Structura specifică a populaţiilor de ixodide din zone cu profiluri geografice diferite din România. Lucr. Ştiinţif. Med. Vet. Timişoara, XXXVII, 970-975.

Pegram RG, Wilson DD, Hansen JW (2000) Past and present national tick control programs. Why they succeed or fail? Ann NY Acad Sci 916:546–554

Sajid Sohail M et al., 2011. Prevalence, associated determinants, and in vivo chemotherapeutic control of hard ticks infesting domestic goats. Par. Res. 108: 601-609.

Teglas M, Matern E, Lein S, Foley P, Mahan SM, Foley J., 2005. Ticks and tick-borne disease in Guatemalan cattle and horses. Vet Parasitol 131:119–127.