EFFICACY OF FLUMETHRIN POUR-ON AGAINST
DAMALINIA CAPRAE OF GOATS (CAPRA HIRCUS)

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ABSTRACT


Goats naturally infested with Damalinia caprae lice were used to evaluate the efficacy of flumethrin pour-on. The maximum load of lice infestation was detected in the neck region. The LC\textsubscript{50} value of flumethrin pour-on against \textit{D. caprae} was found to be 119.35 ppm and the 95\% confidence limits were calculated to be 104.10 and 136.85 ppm. Flumethrin at the rate of 1 mg/kg body weight by pour-on application along the mid-dorsal line was found to be 100\% effective in treating lice-infested goats compared with the control goats. The residual action of flumethrin was found to be at least 42 days during which period no apparent signs of any local or general adverse effects were observed. Based on these studies, it is suggested that flumethrin pour-on may be successfully used for both the prophylaxis and treatment of \textit{D. caprae} infestation in goats and it is necessary to repeat the treatment after 42 days. The method of application is highly advantageous as it can be conveniently applied, even in animals with thick hair coat and during the winter months.

INTRODUCTION

Successful control of lice on sheep and goat flocks depends on the correct method of application of an effective insecticide on the flock, which, in addition to other factors, depends on the distribution of acaricide on the body and redistribution to untreated parts of the body. Failure of treatment has been attributed to incorrect application or insecticide resistance (Johnson et al., 1990; Morcombe et al., 1992; James et al., 1993; Keys et al., 1993). Thus, the pour-on formulation of synthetic pyrethroids became more popular and acceptable due to high efficiency, ease of application and rapid distribution on the body (McEwan Jenkinson et al., 1986).

Flumethrin, a synthetic pyrethroid, has been reported to be a highly effective acaricide by conventional dip, spray and pour-on methods against several species of single- and multi-host ticks of cattle from several countries (Dorn and Pulga, 1985; Hopkins et al., 1985; Sosa, 1985; Gouteux et al., 1996; Bhushan et al., 1998). It has also been found to be very effective against the biting louse \textit{Bovicola bovis} of cattle (Liebisch et al., 1994) and \textit{Bovicola ovis} of sheep (Liebisch and Beder, 1988). It is being marketed as one of the very effective and popular acaricides in many countries and has been reported to be significantly more effective than cypermethrin and alpha-cypermethrin (Rinkanya and Tatchell, 1988; Norval et al., 1996) and has even been reported to be
effective against many tick species which have developed resistance to other synthetic pyrethroids (Nolan et al., 1989). The data on the efficacy of flumethrin, particularly the pour-on formulation, against lice of goats is apparently lacking. The present study was, therefore, undertaken to investigate the in vitro and in vivo efficacy of flumethrin pour-on against Damalinia caprae of goats.

MATERIALS AND METHODS

Experimental animals

Studies were undertaken on 30 adult Barberi goats of either sex, weighing between 18 and 26 kg and naturally infested with lice. These goats were maintained in the Department of Veterinary Physiology. Of the goats, 10 were selected for collecting the lice for in vitro studies while the remaining 20 were divided into two groups of 10 each for the in vivo efficacy trial. Goats from groups I and II were housed in separate pens; however, they were let loose for grazing for 5–6 h daily under the supervision of animal attendants and not allowed to sit or mix with other animals of the flock.

In vitro studies

For the study, 250 live lice were collected by hand picking from 10 naturally-infested goats and the louse species was identified. After 3 h, the lice were randomly divided into 6 groups (I to VI) with 25 lice in each. The dilutions of flumethrin (Bayticol pour-on, 1% w/v; Bayer, Germany) were prepared serially using liquid paraffin. Liquid paraffin was used as a diluent since it is miscible with the base in flumethrin pour-on formulation. The lice of groups I to V were placed in 30 ml culture tubes (25 × 95 mm) containing 6 × 6 cm Whatman Filter paper (No. 1) impregnated/charged with 0.5 ml of 31.25, 62.5, 125, 250 and 500 ppm of flumethrin pour-on respectively, while group VI served as control where the filter paper was impregnated with 0.5 ml of liquid paraffin as described by Johnson et al. (1990). These tubes were tied with a muslin cloth at the mouth of the tubes and kept at 27 ± 1°C and at 70–72% relative humidity in an incubator for 20 h. The mortality of lice in all the groups was noted after 20 h. Probit analysis was done on mortality data (Finney, 1971) to calculate the LC50 value and the 95% confidence limits of flumethrin pour-on against D. caprae.

In vivo studies

Lice load

For in vivo efficacy studies on goats with natural infestation of D. caprae, the burden of lice was assessed by summation of the total of lice counted by using the standard counting technique in the 10 × 10 cm coat openings at each of the five sites on the neck,
shoulder, withers, flank and rump regions of all the goats of both the groups on day 0, i.e. before treatment, as described by Higgs et al. (1994).

Chemical and applications

Flumethrin pour-on (BaytiCol pour-on, 1% w/v; Bayer, Germany) was evenly applied as one continuous strip all along the mid-dorsal line from head to the base of the tail at the dose rate of 1 mg/kg body weight on all the animals of group I, while the animals of group II served as control where a similar volume of liquid paraffin was applied.

Efficacy evaluation

All the animals in both the treatment and control groups were observed and lice populations were assessed as described earlier on days 7, 14, 21, 28, 35 and 42 post flumethrin application. The Henderson–Tilton formula (Chick et al., 1993) was used to determine the per cent efficacy after treatment:

\[
\text{% reduction} = \frac{1 - (Ta/Ca \times Cb/Tb)}{1} \times 100
\]

where

- \(Ta\) = infestation on treated animals after treatment
- \(Tb\) = infestation on treated animals before treatment
- \(Ca\) = infestation on untreated animals after treatment
- \(Cb\) = infestation on untreated animals before treatment

Residual protective effect

The flumethrin-treated goats were closely observed for the reappearance of lice at weekly intervals for up to 7 weeks.

Adverse effects

During the first 4 h following the flumethrin application, again after 24 h, and on the subsequent check-up days, the animals were closely observed and examined for any apparent signs of local or generalized reactions or adverse effects.

RESULTS

*In vitro* studies to calculate the LC\(_{50}\) values of flumethrin pour-on against *D. caprae* in the concentration range of 31.25 to 500 ppm revealed concentration-dependent
mortality of the lice. The LC50 value of flumethrin pour-on for *D. caprae* was found to be 119.35 ppm with the 95% confidence limits of 104.10 and 136.85 ppm.

Table I shows that the lice were found in the highest number in the neck region followed by the shoulders while the rump had the least lice. The geometric mean numbers of *D. caprae* at each of the five sites on the animals of both the treatment and control groups before and after treatment are shown in Table I.

Flumethrin pour-on application at the recommended dose level (1 mg/kg) resulted in 100% reduction in lice population as observed from days 7 to 42 and not even a single louse could be spotted on the body of any of the treated goats. However, in the control group there was an increase in the mean number of lice (Table I). From day 45 onwards some lice started appearing on the body of treated goats. Further, all through the observation period for up to 42 days, none of the treated goats exhibited any apparent signs of toxicity or adverse effects.

**TABLE I**

*Effect of flumethrin pour-on application (1 mg/kg body weight) on geometric mean number of *Damalina caprae* in different body regions of goats (n = 10)*

<table>
<thead>
<tr>
<th>Body region</th>
<th>Lice load</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Treatment</td>
</tr>
<tr>
<td></td>
<td>Day 0</td>
<td>Day 42</td>
</tr>
<tr>
<td>Neck</td>
<td>45.08</td>
<td>63.79</td>
</tr>
<tr>
<td>Shoulder</td>
<td>36.60</td>
<td>49.54</td>
</tr>
<tr>
<td>Withers</td>
<td>22.11</td>
<td>33.04</td>
</tr>
<tr>
<td>Flank</td>
<td>21.53</td>
<td>31.14</td>
</tr>
<tr>
<td>Rump</td>
<td>15.93</td>
<td>27.10</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Lice infestation in animals appears to be more problematic as it involves almost the whole of the animal's body, resulting in itching, animals becoming restless, feeding and sleep are affected, hair coat becomes rough and shaggy and even to the extent that wounds and bruises may be inflicted and animal production goes down.

Results of the present study suggest that flumethrin 1% pour-on is 100% effective in the treatment of lice infestation with *D. caprae* in goats. This result is consistent with the limited reports on the biting louse (*Bovicola ovis*) of sheep (Liebisch and Beder, 1988), *Bovicola bovis* of cattle (Liebisch et al., 1994) and *Haematopinus tuberculatus* of buffaloes (Garg et al., 1997) and also sheep keds (*Melophagus ovinus*) as reported by Liebisch and Beder (1988).

Flumethrin pour-on was found to be completely effective for more than 42 days
against the goat louse as it prevented the reinfestation of treated animals with *D. caprae*. A similar protection period of 42 days has been reported against *Bovicola ovis* in sheep (Liebisch and Beder, 1988) and *Bovicola bovis* in cattle (Liebisch et al., 1994). However, the residual action against buffalo lice (*Haematopinus tuberculatus*) was found to be 21 days (Garg et al., 1997). Further, none of the treated animals exhibited any apparent signs of adverse effects.

There is good evidence that pour-on application of synthetic pyrethroids results in a concentration gradient from the site of application around the animal and the drug is dispersed in the stratum corneum of the epidermis through intercellular channels which are permeated by sebum and sweat (McEwan Jenkinson et al., 1986; Johnson et al., 1990). Further, pour-on applications deliver a greater total amount of synthetic pyrethroid compared to dipping (Johnson et al., 1990). Thus, keeping in view the above mentioned relative importance of pour-on formulations, 100% efficacy of flumethrin 1% pour-on against *D. caprae* infestation in goats, a convenient and simple method of application even during the winter months, prolonged residual action of more than 6 weeks and safe therapeutic usage without any adverse effects on goats merits its use at the dose rate of 1 mg/kg body weight over the other conventionally used insecticides in the long-term control and strategic treatment programmes against lice infestation in goats.

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REFERENCES


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**Efficacité du Flumethrine contre *Damalinia capræ* sur des chèvres (*Capra hircus*)**

**Résumé** – Des chèvres naturellement infestées par des poux de l'espèce *Damalinia capræ* furent utilisées pour évaluer l'efficacité du Flumethrine ‘pour-on’. La zone la plus infestée fut le cou. La DLT50 de ce produit contre *D. capræ* fut de 119,35 ppm avec une marge de confiance de 95% entre 104,10 et 136,85 ppm. Une teneur de 1 mg/kg (pour le produit ‘pour-on’) appliquée sur le dos montra une efficacité de 100% chez les chèvres traitées par comparaison avec les animaux de contrôle. L'action résiduelle fut de 42 jours, pendant lesquels aucun effet contraire ne fut observé. Ces études montrent que l'utilisation du Flumethrine ‘pour-on’ peut s'avérer utile pour le traitement ou une approche prophylactique de l’infestation de *D. capræ* chez les chèvres. Cette méthode est très avantageuse, même chez des animaux avec une toison fournie et pendant les mois d’hiver.

**Eficacia de la flumetrina ‘pour-on’ frente a *Damalinia capræ* en cabras (*Capra hircus*)**

**Resumen** – Cabras infestadas de forma natural con *Damalinia capræ* fueron utilizadas para evaluar la eficacia de la flumetrina administrada mediante un sistema ‘pour-on’. La máxima carga parasitaria se detectó en la región del cuello. El valor LC50 de flumetrina ‘pour-on’ frente a *Damalinia capræ* fue de 119,35 ppm y los límites del intervalo de confianza del 95% fueron 104,10 y 136,85 ppm. La flumetrina a una dosis de 1 mg/kg PV mediante aplicación ‘pour-on’ a lo largo de la línea dorsal tuvo una eficacia del 100% en cabras tratadas en comparación con animales control. La acción residual de la flumetrina fue de al menos 42 días y durante este periodo no se observaron efectos indeseables ni locales ni generalizados. De acuerdo con estos resultados, se sugiere que la flumetrina ‘pour-on’ puede utilizarse con éxito para la prevención y el tratamiento de la infestación por *D. capræ* en cabras, siendo necesario repetir el tratamiento al cabo de 42 días. El método de aplicación es muy ventajoso ya que puede utilizarse incluso en animales con una capa gruesa de pelo y durante los meses de invierno.