Efficacy of orally administered powdered aloe juice (*Aloe ferox*) against ticks on cattle and ticks and fleas on dogs

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ABSTRACT

The efficacy of orally administered powdered aloe juice (*Aloe ferox*) was evaluated against ticks on cattle and against ticks and fleas on dogs. Twelve calves were each infested over a 25-day period with approximately 4000 larvae of *Rhipicephalus* (*Boophilus*) *decoloratus* and allocated to 3 groups of 4 calves each. Three days after the last larval infestation and daily for 22 days thereafter, the calves in 1 group were fed 5 mg/kg body weight and those in another 25 mg/kg body weight of powdered aloe juice incorporated in game maintenance pellets, while the animals in the 3rd group received only pellets. Detached female ticks were collected daily and counted and the weights and the fertility of groups of 50 engorged female ticks collected from the animals were ascertained. The powdered aloe juice in the game maintenance pellets had no effect on the tick burdens of the calves or on the fertility of the ticks. Six dogs, in each of 2 groups, were treated daily for 15 consecutive days, commencing on Day –5 before the 1st tick infestation, with either 0.39 g or 0.74 g of powdered aloe juice, administered orally in gelatin capsules, while a 3rd group of 6 dogs served as untreated controls. All the dogs were challenged with *Haemaphysalis leachi* on Days 0 and +7, and with *Ctenocephalides felis* on Days +1 and +8, and efficacy assessments were made 1 day after flea and 2 days after tick challenge, respectively. Treatment was not effective against ticks or fleas on the dogs.

Key words: *Aloe ferox,* antiparasitic, calves, dogs, fleas, powdered aloe juice, ticks, traditional medicine.

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INTRODUCTION

Seventy-three per cent of African communal farmers in the Eastern Cape Province of South Africa use herbal remedies for their livestock because they are cheap, locally available, convenient to administer and because they believe that they are effective[6]. They also use these remedies because they are unfamiliar with, or unaware of, modern medicines and their efficacy, or consider them to be too expensive[6]. Rural stockowners either prepare the herbal remedies themselves or purchase them from herbalists, who use various parts of fresh plant material to produce infusions, decoctions, juices, pastes and powders[6]. A particularly well-known and highly regarded medicament is the juice of the leaves of *Aloe ferox.* This juice is obtained by lopping off the lower leaves of the aloes and placing them, cut surface inwards and downwards over a container so that the liquid that drains from them can be collected. Juice collected in this way is concentrated by boiling and is left to crystallise . The crystals are either used *per se* or are powdered before use. It has been claimed that the crystals are effective for the control of ticks, but because they are unpalatable they must be administered to animals either mixed with food or dosed orally in soluble capsules.

Powder obtained from the air-dried leaves of *Aloe marlothii* and mixed with cowpeas at a concentration of 6 % (w/w) has displayed some effect on both oviposition and adult emergence of cowpea beetles, *Callosobruchus maculatus*[5]. While ash obtained by burning a dried leaf of this aloe, mixed with maize kernels at a concentration of 5 % (w/w) has proved to be highly effective in killing adult maize weevils, *Sitophilus zeamais* as well as having a marked effect on their oviposition[1]. Furthermore, ethanol and water extracts of the leaves of *A. marlothii* have shown some activity against the free-living nematode *Caenorhabditis elegans*[7].

Although the use of ethno-veterinary remedies is common amongst communal farmers, few commercial farmers make use of them. However, this pattern is changing with the perception of many commercial farmers that herbal remedies may be effective as well as inexpensive parasiticides. This notion has led to the introduction of crystallised *A. ferox* juice into commercial markets and it is either marketed in its raw form or as a component of animal feeds. Despite the fact that there is no scientific evidence to corroborate their efficacy, these products are sold with the claim that they will control internal and external parasites in and on livestock and companion animals. The only proof in support of this antiparasitic activity is based on the subjective observations of the consumers themselves, who maintain that the remedies are effective.

Ticks are frequently a problem on wildlife in small nature reserves because of overstocking, incorrect species mixes, the introduction of species not indigenous to a region, or other management problems. They are difficult and often expensive to control under these circumstances, and because there is an old belief that wild ungulates eat aloes to control ticks[3], some wildlife farmers have resorted to the use of powdered aloe juice to achieve this. The powdered juice is incorporated in game maintenance pellets during the manufacturing process, and the manufacturers contend that the medicated pellets are effective for the control of ticks on wildlife. Antiparasitic properties are also attributed to the crystalline form of the juice of *A. ferox,* marketed as 'Bitter Crystals'. According to the manufacturers, daily administration of a match-head sized quantity (40 mg) of crystals will rid animals of ticks and fleas and prevent further infestation with external parasites.

Two laboratory efficacy studies were carried out in order to verify these claims. The 1st was designed to determine the efficacy of powdered aloe juice incorporated in game maintenance pellets against artificial infestations of the tick *Rhipicephalus* (*Boophilus*) *decoloratus* on cattle, and the 2nd was devised to evaluate the efficacy of orally dosed aloe juice crystals against artificial infestations of

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the tick *Haemaphysalis leachi* and fleas *Ctenocephalides felis* on dogs.

MATERIALS AND METHODS

Cattle

The experimental design is summarised in Table 1. Twelve 6–8-month-old Friesian-type calves, weighing between 120 and 230 kg and not treated with an acaricide for at least 6 weeks prior to the 1st tick infestations, were used. On 9 occasions between Day –28 to Day –3 before treatment, the calves were each infested with approximately 200 to 1000 *R.* (*Boophilus*) *decoloratus* larvae to a total of approximately 4000 ticks. They were allocated to 3 groups of 4 animals each by randomisation through minimisation with pre-treatment tick counts (Day 7 to Day 1) as principal criterion. From Day 0 to Day +21 the calves were individually penned and those in the 2 treated groups were fed Senwesko® Game maintenance pellets into which 2500 g of powdered aloe juice per 1000 kg of pellets had been incorporated. Each morning calves in one group were fed 200 g and those in another 1000 g of medicated pellets per 100 kg body weight. This translated to daily dosage levels of 5 mg and 25 mg powdered aloe juice/kg body weight, respectively, for the calves in the 2 groups. Once they had consumed all the medicated feed they, with the untreated control group of calves, were allowed unlimited access to conventional game maintenance pellets. Water was available *ad libitum.*

Daily, between Days +3 and +20 after the commencement of treatment, all engorged female ticks that detached from the calves were collected and counted. In addition from Day +3 to Day +21, 50 engorged female ticks were collected from each group of calves and weighed and their fertility determined by allowing them to oviposit and the eggs to hatch.

Efficacy was calculated using the following equation:

$$E(\%) = \frac{C-T}{C} \times \frac{100}{1} \text{ where}$$

E = percentage efficacy, C = mean number of ticks collected from the control group, and T = mean numbers of ticks collected from the treatment groups.

Dogs

The experimental design of this study is summarised in Table 2. Eighteen cross-bred dogs, of both sexes, older than 6 months and each weighing more than 6 kg were infested with 100 *C. felis* on Day –7. On Day –6 all fleas were removed and counted, and the dogs were ranked according to their Day –6 flea counts and allocated to 3 groups of 6 dogs each by randomisation through minimisation. An attempt was also made to balance the groups according to individual animal weights.

Each dog was separately housed in a pen consisting of a built-in sleeping area with under-floor heating, and an outside run. The pens had concrete floors, which were cleaned daily with pressurised water, and were separated by brick walls so that no contact between dogs was possible. The dogs were fed commercially available dog cubes once a day and fresh water was available *ad libitum.* The accommodation was in compliance with the 'National Code for Animal Use in Research, Education, Diagnosis and Testing of Drugs and Related Substances in South Africa'.

After ranking, and commencing 5 days before the 1st tick infestation, the dogs in the treated groups were dosed with powdered crystallised aloe juice for 15 consecutive days. Because the manufacturer could give no indication of a specific dose rate per kg of body weight, arbitrary dosage levels of 0.39 g or 0.74 g of crystals daily were chosen. The aloe crystals intended for each dog were poured into 2 gelatine capsules, and these were presented to the dogs in a pat of minced-meat. If a dog refused to eat the meat the capsules were administered manually, directly into its throat.

Five days and again 12 days after the commencement of treatment each dog was artificially infested with 50 unfed, at least 2-weeks-old, adult *H. leachi* of a laboratory-bred South African strain. In addition, each dog was also infested 6 days and again 13 days after the commencement of treatment with approximately 100 unfed fleas from a laboratory bred, South African strain of *C. felis* (routinely fed on cats), that were less than 1 week old.

Two days after each tick infestation and 1 day after each flea infestation, the dogs were examined for ticks and fleas, with the dogs in the untreated control group examined first. Ticks were simultaneously collected from the same dog by 2 persons who ensured that all body regions were properly covered. Ticks were removed with forceps and placed in vials for later counting before combing the dogs for fleas. Fleas were collected from the dogs by combing their coats with a fine-toothed flea comb[4]. Combing entailed making several strokes with the comb following the lie of the hair. The operator moved from 1 part of the animal's coat to the next by performing overlapping strokes so that no body region was missed. Three operators were involved in collecting fleas from a dog. One person restrained the animal, a 2nd combed it and the 3rd was responsible for counting the fleas recovered on each comb.

Efficacy against adult ticks and fleas was calculated using the same equation as that employed for the efficacy study on the calves. A 1-way ANOVA was used to

Table 1: **Experimental design: infestation, treatment and assessment of efficacy of feed pellets containing powdered aloe juice against ticks on cattle.**

Day	Activity
–28 to –3	Each of 12 calves infested on 9 occasions with *R. (Boophilus) decoloratus* to a total of 4000 larvae
–1	Calves allocated to 3 groups of 4 animals each
0 to +21	Medicated pellets fed daily to calves in 2 of the groups
+3 to +21	All engorged female ticks that detached collected and counted daily
+3 to +20	Fifty engorged female ticks collected from each group on 6 occasions for fertility observations

Table 2: **Experimental design: infestation, treatment and assessment of efficacy of powdered aloe juice against ticks and fleas on dogs.**

Day	Activity
–7	Eighteen dogs each infested with 100 fleas
–6	Fleas removed and counted. Dogs allocated to 3 groups of 6 dogs
–5 to +9	Powdered aloe juice administered daily
0	Each dog infested with 50 ticks
+1	Each dog infested with 100 fleas
+2	Ticks and fleas removed and counted
+7	Each dog infested with 50 ticks
+8	Each dog infested with 100 fleas
+9	Ticks and fleas removed and counted

Table 3: **Mean total numbers of female ticks that detached from calves receiving feed pellets containing powdered aloe juice and the mean masses of eggs produced by detached ticks.**

Item	Treatment with powdered aloe juice (4 calves/group)		
	Untreated controls	5 mg/kg body weight/day	25 mg/kg body weight/day
Mean total numbers of female ticks that detached (range of daily mean detachments)	230.8 (1.0–37.8)	437.0 (0.8–91.5)	247.8 (2.5–46.3)
Mean mass of engorged females (g)	0.251	0.250	0.246
Mean egg mass (g) produced by each female	0.101	0.097	0.103
Egg mass/female mass	0.402	0.388	0.419

Table 4: **Tick and flea counts on experimentally infested dogs treated orally with powdered aloe juice.**

Group (*n*)	Mean body weight (kg)	Treatment	Mean flea count (range)			Mean tick count (range)	
			Day –6	Day +2	Day +9	Day +2	Day +9
1 (6)	12.0	390 mg powdered aloe juice/day	22.8 (4–48)	36.3 (12–62)	41.3 (19–74)	16.5 (8–26)	13.0 (7–16)
2 (6)	10.2	740 mg powdered aloe juice/day	20.8 (7–38)	44.3 (14–72)	47.6 (24–59)	15.3 (7–20)	22.0 (17–29)
3 (6)	11.2	Untreated controls	20.7 (8–37)	33.7 (16–45)	44.5 (33–63)	16.2 (6–30)	16.0 (9–24)

determine whether there was a significant difference ($P < 0.05$) between the mean tick and flea counts of the 3 groups of dogs on each assessment day.

RESULTS

The numbers of engorged female ticks that detached from the calves and the weights and fertility of the ticks that were allowed to oviposit are summarised in Table 3. A mean of 230 engorged ticks were collected from the control group of 4 calves over the 22-day treatment period. This was less than the means of 437 and 247 ticks collected from the 2 treated groups. There was no significant difference between the weights of the engorged female ticks that had been collected from the various groups between Days +3 and +20, nor between the weights of the egg masses produced by these females, nor did the powdered aloe juice affect egg hatchability.

With the exception that the 2nd set of tick counts on the dogs treated with aloe crystals at the higher dosage level was significantly larger than those of the dogs in either of the other 2 groups (Table 4), the tick and flea counts of the treated and control dogs did not differ significantly.

DISCUSSION

Cattle

The parasitic phase of the 1-host life cycle of *R.* (*Boophilus*) *decoloratus* requires approximately 23 days to complete on cattle, with the immature stages, namely larva and nymph each spending approximately 1 week on the host before moulting to the next stage and the females requiring approximately 1 week in which to mate and engorge before detaching[2]. The infestation and treatment schedule followed in this study ensured that all developmental stages were present on the calves before treatment commenced and that all stages of development would have been present during the 21-day period of treatment. The daily dosage levels of powdered aloe juice employed were those recommended by the manufacturer of the medicated game pellets and a dosage level that was 5 times higher. Neither of these dosage levels had any effect on the magnitude of the tick burdens of the treated calves compared with those of the untreated controls, nor did they affect the fertility of the ticks.

Dogs

One would have to assume that the powdered aloe juice crystals, or one or more of its constituents or metabolites, has a systemic mode of action if their oral administration is to have an effect on haematophagous ectoparasites such as ticks and fleas. Consequently, ample time was allowed between the commencement of treatment and the 1st artificial infestations with ticks and fleas and assessments of efficacy. The tick and flea infestations on Day 0 and Day +1, respectively, and the efficacy assessments on Day +2 were done to determine the immediate, or therapeutic efficacy of the crystals, while those on Days +7 to +9 were performed to determine whether there was any cumulative effect of prolonged pre-dosing with crystals. In addition, both daily dosage levels of crystals administered to the dogs were considerably higher than that recommended by the manufacturer (390 or 740 mg compared to 40 mg). Despite these measures, there was no indication of immediate efficacy or of cumulative efficacy against either ticks or fleas on dogs. In fact, at the 2nd efficacy assessment the dogs treated at the higher dosage level had significantly more ticks than dogs in either of the other 2 groups. If this observation is not fortuitous it would seem as if treatment with powdered aloe juice had a potentiating effect on tick attachment. The results demonstrate that aloe juice crystals, administered at the dosage rates and schedule employed in this study, had no effect on artificial infestations of *H. leachi* or *C. felis* on dogs.

No adverse reactions resulting from treatment were recorded, and the mean body weights of the dogs before and after treatment did not differ significantly. This implies that probably even higher dosage levels of crystallised aloe juice can be administered to dogs. However, the tick and flea assessments do not justify the use of even higher dosage rates since no indication of efficacy was observed at either of the dosage levels employed. Higher dosage levels may also induce diarrhoea because in humans an oral dose of crystals about twice the size of a match head is taken as a laxative[8].

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