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Comparative study of the acaricidal activity of cashew balsam and inothrin 5% pour-on (Cypermethrin) on cattle ticks

Dourossimi Adam ADENILE [1], Sessiwede Ingrid Nadine ANAGONOU [1,*], Fernand Kouassi TOUGLOAFFANOU [2] and Martial Régis LANMADJEKPOGNI [2]

[1] *Laboratory of Ethnopharmacology and Animal Health, School of Sciences and Techniques of Animal Production, University of Abomey-Calavi, 01 BP: 526 Cotonou, Benin.*
[2] *Higher Normal School of Technical Education of Lokossa, BP 133 Lokossa, Bénin.*

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Abstract

The growing resistance of ticks to synthetic pyrethroids is a serious global problem that is motivating researchers to identify new biomolecules with broad acaricidal activity. Plants and their derivatives are often used in traditional medicine. This is the purpose of the present study which focused on the comparative study of the effect of an ointment based on cashew balsam and inothrin 5% on ticks in Borgou cattle. During the study, ticks were collected on three different farms. They were then identified to specify the tick fauna affecting the cattle. 72 young Borgou cattle aged 1-2 years were divided into six lots of 12 animals and used for the study. Five treatments of cashew balsam and one treatment of 5% inothrin pour-on were used at a frequency of 72 hours with reapplication in the cases where the ticks were still alive. The study showed that the anogenital area is the most infested area by ticks. A lot of animals treated with 25% cashew balsam and 75% shea butter applied directly twice at three-day intervals recorded 100% tick mortality on day 7 and no corrosive effect on the animals' skin. The product inothrin 5% pour-on is as effective on ticks as the ointment with 25% cashew balm and 75% shea butter in direct application.

Keywords: Inothrin 5%; Cashew balm; Shea butter; Tick; Borgou cattle

1. Introduction

As with cattle in other West African countries, cattle in Benin are subject to various parasitic attacks, among which ticks occupy a prominent place. These ticks transmit multiple diseases. Among such diseases are cowdriosis, anaplasmosis, theileriosis, and babesiosis. Tick infestations also lead to the development of dermatophilosis, a bacterial skin disease with varying degrees of severity [1]. In addition, each of these diseases has risks of immunosuppression and negative impacts on the biochemical parameters of the parasitized organism.

To remedy these difficulties, synthetic acaricides are used in intensive production systems to fight and control these ectoparasites [2]. However, the consequences on humans and their environment, the presence of acaricide-resistant strains of mites, and the high cost of good quality products on local markets impose the search for alternative solutions [3].

In this context, it seems appropriate to find alternative ways, hence the interest in agro-resources that would have undeniable acaricidal effects, with fewer side effects. The context indicated, explains the choice of the cashew apple, false fruit of *Anacardium occidental L*.

* Corresponding author: Sessiwede Ingrid Nadine ANAGONOU
Laboratory of Ethnopharmacology and Animal Health, School of Sciences and Techniques of Animal Production, University of Abomey-Calavi, 01 BP: 526 Cotonou, Benin.

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The cashew tree is native to the tropical regions of America, particularly Brazil, and is a tree 8 to 10 meters high, belonging to the *Anacardiaceae* family, which also includes the mango tree (*Mangifera indica L.*) and the pistachio tree (*Pistacia vera L.).* With a diameter that can reach 12 to 15 meters, it has dense and branched foliage. The fruit, the cashew nut, hangs at the end of a fleshy, juicy stalk, red or yellow when ripe, called the cashew apple [4].

Cashew almonds are very rich in vitamin C (Memento of the agronomist). They contain unsaturated fats, omega fatty acids, and arginine which respectively decrease the level of bad cholesterol, help the heart and improve the health of the artery walls by making them more flexible and less exposed to blood clots thus avoiding cases of a heart attack. The content of vitamin C (ascorbic acid) in a cashew apple is almost ten times higher than in pineapple and four times higher than in oranges [5].

Cashew Nut Shell Liquid (CNSL) is an acidic, highly corrosive product that is extracted from the (cashew) nutshell. Phenolic compounds are the main constituents of Cashew Nut Shell Liquid. These are anarcadic acid, cardanol and cardol [6]. Cashew balm has a vesicant action on the skin as well as allergic effects caused by cardol or cardanol.

Cardol is mainly used in the manufacture of drugs, particularly for the prevention and treatment of arrhythmia (abnormal heartbeats) and other conditions, while anarcadic acid is used to control Plasmodium falciparum, which causes malaria [7]. It is effective and can replace synthetic insecticides in the control of termites and other insects [8, 9]. The action of cashew balsam's toxicity has affected Aedes aegypti larvae [10].

In traditional medicine, several parts of the cashew tree are used to cure diseases. The roots are used as a purgative, to cure coughs; the bark is used in the treatment of hypertension and dysentery [11]; the leaves are used in the treatment of dysentery, measles, hemorrhoids, gonorrhea [12]; the fruit is used as a vermifuge and the apple has medicinal properties. The fruit relieves ulcers and toothache [13]. The apple is an anti-influenza and anti-diabetic agent. It is used to treat scurvy, diarrhea, neurological pain, and rheumatism. It is also effective in the prevention of cholera: (FAO, 2004). According to pharmacological studies, the aqueous extract of the cashew apple, endowed with self-regulating glycemic activity, contains saponosides and flavonoids [14].

The caustic oil of walnuts treats scabs. The decoction of the bark is used as an antihypertensive and anti-dysenteric [15].

In Benin, the specie is cultivated essentially in the center of Benin, in particular in the Departments of Zou and Collines, Atacora, and Donga because of the ecological conditions that are globally favorable and the availability of agricultural land [16].

To find an alternative to synthetic pyrethroids, this study compared the efficacy of an ointment based on cashew balm with a synthetic pyrethroi.

2. Material and methods

2.1. Material

During the month of December 2020, the fruits of the cashew tree were harvested from the trees or picked up after they had fallen. Coming from Bantè, a city located in the center of Benin, the fruits whose apples are red or yellow in color without any injury, have been selected. Then they were carefully separated from the nuts. The nuts were cracked and their shells collected.

2.2. Methods

2.2.1. CNSL extraction method

The crushing of the shells was done in the laboratory with a stone mortar and pestle, then we carried out the extraction directly without any prior treatment. The raw hulls were put in an autoclave, then they were weakened. Then they were subjected to the press for steam extraction at 10 bars (corresponding to 180°C). The CNSL obtained by this process contains 42% cardol, 47% anacardic acid, and 3% cardanol [17].

Method of obtaining cashew balm ointment

Shea butter was melted over low heat. Then it was weighted according to the percentage that the preparation must contain. Then the shea butter was mixed with the cashew balm.

As conventional acaricide INOTHRINE 5% Pour On (Cypermethrin) was used.

2.2.2. Animal material

The animal material consists essentially of cattle of all ages, all sexes of the Borgou race.

Three farms were identified with a high prevalence of infestation. On each farm, two lots of twelve animals each were placed, giving a total of six lots of twelve animals.

Table 1 Constitution of Lots

Lots (1-6)	Doses (D1-D6) %
Lot 1	100% B – 0% SB
Lot 2	75% B – 25% SB
Lot 3	50% B – 50% SB
Lot 4	25% B – 75% SB
Lot 5	0% B - 100% SB
Lot 6	INOTHRIN 5% Pour-On

NB: B= Balm, SB= Shea butter.

Lots 2, 3, and 4 were treated with ointments containing respectively; 75% B and 25% SB, 50% B and 50% SB, and 25% B and 75% SB while lots 1 and 5 were treated respectively with ointments containing 100% B and 0% SB and 0% B and 100% SB. Lot 6 received INOTHRINE 5% Pour-on.

The data was processed in excel software.

After direct application of these different ointments, the number of ticks was registered on day three per body region, per animal, and lot. The application was repeated in cases where ticks were still present on the animals. The tick mortality rate was deduced.

$$T = \frac{number\ of\ ticks - number\ of\ remaining\ ticks}{number\ of\ ticks}\ X\ 100$$

3. Results

On all the farms investigated, a total of 672 ticks were collected, which were divided into three genera: *Amblyomma, Boophilus, and Rhipicephalus*. Of the 672 ticks collected, the genus Boophilus was the most common with 484 ticks out of 672, i.e., 72.02%. The genus Amblyomma (in particular *Amblyomma variegatum*) comes in the second position with 168 ticks out of 672, i.e., 25%, while the genus Rhipicephalus is the least encountered with 20 ticks out of 672, i.e., 2.97%.

Table 2 Number of Ticks per Day

LOTS	DAY 1 (1st treatment)	DAY 4 (2nd treatment)	DAY 7 (lastverification)
1	88	0	0
2	56	0	0
3	64	0	0
4	48	24	0
5	140	140	152
6	28	8	0

Table 3 Tick Mortality Rates

Mortality rate %		
Lots	**Day 4 (2nd treatment)**	**Day 7 (last verification)**
1	100%	100%
2	100%	100%
3	100%	100%
4	50%	100%
5	0%	0%
6	71,42%	100%

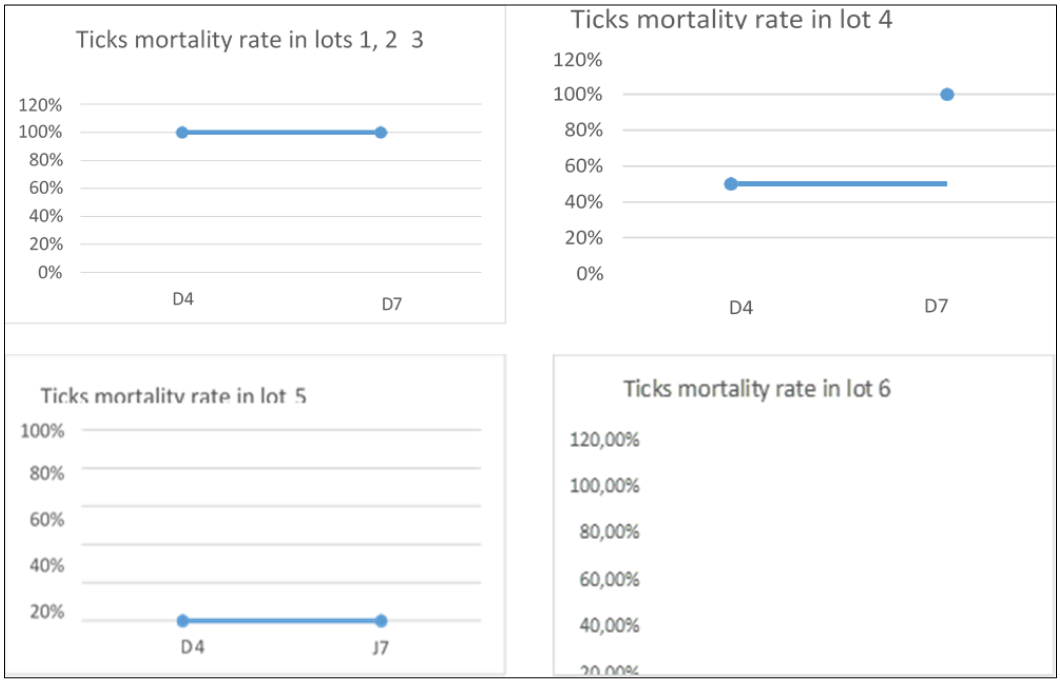

Figure 1 Tick Mortality Rates

4. Discussion

Plants have long played a very important role for mankind, as they can synthesize a large number of complex organic molecules often with potential biological activities. They have traditionally been used for healing, relaxation, flavoring, and preserving food and other products [18]. The African continent is endowed with very rich biodiversity with many plants used as natural foods and also for therapeutic purposes. The side effects of synthetic molecules and economic constraints have led in recent years to the use of medicinal plants for therapeutic purposes [19]. Among the most widely used plants in Benin, the cashew tree ranks high. Several of its parts are used to cure various ailments.

Tick control remains a major problem for all livestock farmers. As reported by some authors, most of the tick species are resistant to pyrethroids and amidine in Brazil [20, 21, 22] and the abusive use of chemical products for its control has accelerated the appearance of resistance phenomena.

Preliminary studies by Akpo et al., (2017) [23] assessed the sensitivity of cold extracted CNSL on pyrethroid-resistant An. gambiae larvae. From the results of the present studies, we found that the cashew balsam ointment appeared to be effective against cattle ticks.

In lots 1, 2, and 3, which respectively received ointments composed of 100% cashew balsam and 0% shea butter, 75% cashew balsam and 25% shea butter, 50% cashew balsam and 50% shea butter; already in 24 hours, the mortality rate is 100%. Although the ticks were all dead in these lots within 24 hours, it should be noted that this mortality was accompanied by depilation and some bleeding, which was more pronounced in lots 1 and 2 than in lot 3. Indeed, cashew balsam is a rather original secondary production: extracted from the shells of the nut, this corrosive liquid, rich in phenolic compounds, is used in the chemical industry [24]. The balsam, therefore, has a corrosive effect on the animals' skin.

On the other hand, in lot 4, which received an ointment composed of 25% cashew balsam and 75% shea butter, the tick mortality rate increased from 50% to 100% between day 4 (2nd treatment) and day 7 (last check) without any effect on the skin of the animals, whereas in batch 6, which received INOTHRINE 5% Pour on, the tick mortality rate increased from 71.42% to 100% between day 4 (2nd treatment) and day 7 (last check). The ointment composed of 25% cashew balsam and 75% shea butter in the direct application used twice alternated by three days has, therefore, a similar effect to that of INOTHRINE 5% pour-on.

The mortality rate of ticks in lot 5, which received only shea butter, was zero and decreased from day to day. The number of ticks increased progressively, unlike the lot treated with INOTHRINE 5% pour-on or with the ointment containing 25% cashew balsam and 75% shea butter. This could be explained by a reinfestation of the animal by ticks and a progression of the infestation.

Indeed, the lot that did not receive any acaricide treatment (lot 5) during the experiment experienced a progressive increase in tick numbers. The parasite load was especially increased in these cattle; this is due to the humidity because the experiment started in mid-June when it was still raining. These results are consistent with those of Farougou et al., (2006) [25] who explained that there is a positive linear correlation between rainfall and the number of ticks collected in Benin. The results of the present study indicate that cashew balsam does have an acaricidal effect on livestock ticks. Indeed, the acaricidal activity of cashew balsam was compared to that of INOTHRINE 5% Pour-on which is a synthetic acaricide used by farmers in Benin. The results showed that the effect of the ointment composed of 25% cashew balsam and 75% shea butter in direct application on ticks is similar to that of INOTHRINE 5% pour on. This suggests that cashew balsam used at 25% in combination with shea butter could represent an alternative to the use of synthetic products which are generally expensive and difficult to obtain in the tropics and especially for low-income livestock farmer.

5. Conclusion

The present study has allowed the preparation and testing of an ointment to control ticks. Its application and wide dissemination to farmers and agro-farmers would be inexpensive and respectful of the environment and the health of the population by drastically reducing synthetic acaricide residues in animal products. In this context, the research of new strategies could focus on the formulation of bio acaricides to circumvent the phenomenon of resistance to acaricides and respect the environment.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

No conflict of interest.

Statement of ethical approval

The different experiments are carried out in an ethical manner in accordance with national and international law.

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