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Ethno-Veterinary and Medical Knowledge of Crude Plant Extracts and its Methods of Application (Traditional and Modern) for Tick Control

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Abstract: Ticks are obligate haematophagous external parasites of mammals, birds and reptiles throughout the world. Ticks bites and tick-borne diseases continue to be a serious public health problem throughout the world. Ticks are responsible for substantial economic losses to the livestock industry. Ticks transmit viral, rickettsial, bacterial and protozoal diseases affecting wild, domestic animals and humans. The genera *Hyalomma*, *Boophilus*, *Rhipicephalus*, *Argas* and *Ornithodoros* are commonly found in Egypt infesting farm animals. They are known to transmit infectious agents to humans and domestic animals such as Dohori, Thogoto and Wanowrit viruses, the rickettsia such as *R. conori* and several protozoa. More and more chemical acaricides have been synthesized and tick resistance to these chemical pesticides poses a serious threat to most farmers worldwide. The high cost of these acaricides, food and environmental contamination forced many farmers across the globe to spend a large percentage of their time and money on the management of ticks and tick-borne diseases. For the above mentioned reasons, researchers around the globe are looking for botanical pesticides as an alternative new safe method for tick control. Botanical pesticides have different properties from plant to plant. They are processed in various ways which include: preparation of the crude plant materials, plants extraction by the use of different solvents or resins, purifying the chemicals isolated from plants and identifying their structure. Botanical pesticides have various effects against ticks such as reducing tick feeding, molting, fecundity and viability of eggs. They are also toxic to nematodes, mites and have antifungal, antivirus and antibacterial properties against pathogens. Therefore, botanical pesticides have many advantages over synthetic chemicals i.e., minimal mammalian toxicity, minimal impact on pollinators and natural enemies, minimal environmental pollution, being less expensive and easily available. In this article, some light were thrown on natural products (medicinal plants) as alternative methods to control of ticks.

Key words: Ticks · Plant extract · Toxic effect · Repellent · Animal · Plant compound

INTRODUCTION

Natural products offer world's resource-poor farmers a cheaper alternative to synthetic acaricides. There is a great potential for the use of Africa's, Asia and South America tropical and subtropical regions plants to develop sources of acaricides to reduce the cost of tick control. These plants, being locally available and potentially easy to be produced, locally processed and used by farmers themselves or by cottage industries is an asset for the use of these plants and their extracts by traditional farmers in poor regions of the world. Farmers are not only the end users of these natural biocides, but they also form the source of the traditional knowledge about the use of these natural products.

The ethno-veterinary and medical knowledge offers a range of herbs to be evaluated for their insecticidal and acaricidal properties. The ingredients of these plants and herbs are known to possess insecticidal, growth inhibiting, anti-molting and repellent activities. A number of reports are available on the effect of different extracts of plant material on tick species [1,2].

Acaricidal Role of Plant Extracts

Toxic Effect: Some plant extracts are capable of reducing tick feeding, moulting, fecundity and viability of eggs.

Tephrosia vogelii leaf extracts have been observed to be highly toxic to 1-, 2-and 3-host ticks. Cattle sprayed with this extract had a residual protection period from re-infestation by ticks for 10 days. Kaposhi [3].

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Williams [4] and Kandill *et al.* [5] used extracts of *Artocarpus altilis* Park; *Azadirachta indica*; *Sea anemone* and *Simmondisa chinensis* against adult female ticks of *Boophilus microplus* and *B. annulatus*. They found that these plants have a severe effect on the reproductive physiology and mortalities of the female ticks.

Some plants can have direct effects (i.e. without extraction) on the target. Frenandez-Ruvalcaba *et al.* [6] evaluated the anti-tick effects of the tropical legumes *Stylosanthes humilis* and *S. hamata* in comparison to the two common grasses, *Cenchurus ciliaris* and *Andropogon gayanus*, on plots, experimentally infested with larvae of the tick *Boophilus microplns*. They found that the anti-tick effect, due to *Stylosanthes spp.* was significantly higher than the common grasses and slightly better for *S. humilis* (3% survival) than for *S. hamata* (12% survival). Kaaya [7] stated that *Stylosanthes* plants produce viscous fluids that poison and kill ticks.

There are many factors that affect the acaricidal activity of the extract including; solvent, extraction time, extract concentration, extracted plant age, target organism (ticks) and exposure time [8,9]. The first author [8] revealed that chlorhydric acid was the most appropriate medium for the extraction of *Stemone tubercle* and the optimum time for extraction was from 12 to 24 hours (longer extraction time diminished the effect of the extract). He also showed that the suitable concentration of the *stemone tubercle* extract for killing the ticks was 5%. Whereas, the overall mortality of the larvae of *Rhipicephalus sanguineus*, *Boophilus microplus* and *Haemaphysalis intermedia* was significantly influenced by the tick species, age of plant used for extraction and the period of tick exposure [9]. Moreover, high overall larval mortality (31.6%) was observed when the larvae was exposed to the 7 month-old plant; it was the lowest (7.49%) at the 10-month-old *Stylosanthes scabra*.

On the other hand, to study the effect of the extraction time on the acaricidal activity, Chungsamarnyrt and Jansawan [10] dipped mature *Tamarindus indicus* in water and 10% ethanol for 24 h, 48 h and 7 days and the resulted extractions were tested against the engorged female cattle tick *B. microplus*. They reported that the mean corrected mortality of ticks were 56-70, 70-89 and 77-99% after dipping for 24 h, 48 h and 7 days, respectively. They also determined the bioassay of organic acids in tamarind fruits (oxalic, malic, succinic, citric and tartaric acids) for their acaricidal activity. Oxalic acid of 0.5 and 1% concentration exhibited the highest acute acaricidal activity (56 and 62% mortality of ticks, respectively, after 24 h of dipping). Tartaric acid at 1% concentration, showed the highest delayed acaricidal activity (73% mortality of ticks 7 days, after dipping). There was no synergic effect i.e. the acaricidal activity of the mixtures was not stronger than those of each individual acid. Both the crude extract of tamarind fruits and their organic acids caused patchy haemorrhagic swelling on the skin of ticks after dipping for 15 min.

Plant extracts might be used in a powder form or diluted with a solvent. Choudhary *et al.* [11] found that the undiluted aqueous extract or powder and 50% diluted aqueous extract of *Nicotiana tabacum* had immediate effect on mortality of the engorged adult *R. haemaphysaloides* and its fecundity production of female. Kaaya *et al.* [12] also showed that water soluble extract of *Margaritaria discoidea* induced high mortalities in nymphs of both *R. appendiculatus* and *Amblyomma variegatum* and in adult *R. appendiculatus*, but not in adult *A. variegatum*, but hexane extract from dry wood of this plant was found to be more acaricidal and a 6.25% concentrated extract killed 100% nymphal *R. appendiculatus*, 100% adult *R. appendiculatus* and 100% adult *A. variegatum* when exposed to the extract for 10 minutes.

The mortalities of *Stemona collinsae* extract (50% concentration) found in 'seed' and engorged nymph and adult of *B. microplus* ticks at 24 h were 100 and 93.33%, respectively. No side effects of the plant extracts were observed in calves [13].

Plant extracts can be used in combination; Chungsamarnyart *et al.* [14] studied thirty-four crude ethanolic plant extracts for its acaricidal activity in combination against the engorged female tropical cattle tick (*B. microplus*). The concentration of the crude extract was 2.5% in a mixed solution of 9 parts of 1% Tween 80 and 1 part of 100% ethanol. Acute acaricidal activity (seen after dipping the plant for extraction for 24 or 48 h) was found for the following combined extracts: *Aganonerion polymorphism* + *Calolropis procera*, *A. polymorphism* + *Anethum graveolens* and *C. procera* + *Pentapetes phoenicia*. Delayed acaricidal activity (observed after dipping for 7 days) was demonstrated by *A. polymorphism* + *C. gigantea*, *A. polymorphism* + *Cryptostegia grandiflora*, *A. polymorphism* + *Ixora nigricans*, *C. gigantea* + *C. grandiflora*, *C. gigantea* + *P. phoenicia*, *I. nigricans* + *A. graveolens* and *Annona muricata* + *Piper nigrnm*.

Marine plants also had acaricidal activity, Williams [15] showed that the topical application of crude ethanol marine plant extracts of *Laurencia obtusa*, *Padina vickerisiae*, *Liagora farinosa*, *L. elongate* and *Stypopodium lobalum* affected the survival of engorged adult female *B. microplus* and inhibited oviposition and embryogenesis on this tick.

Massoud *et al.* [16] showed that the LC_{50} of Myrrh *Commiphora molmol* extract against the fowl tick *Argas persicus* was 1.28, 0.88, 0.84, 0.50 and 0.42% at 1st, 2nd, 3rd, 6th and 12th day, respectively. They also found that Myrrh can rapidly penetrate the cuticle to body cavity, destroy the epithelial gut cells and finally cause the death of ticks.

The anti-tick properties of the root extracts of *Senna italica* subsp. arachoides against the adults of *Hyalomma marginatum* rufipes were studied. Of the hexane, chloroform, dichloromethane, ethyl acetate and methanol extracts tested, only ethyl acetate extracts proved to be potent against adults of *H. marginatum* rufipes. The acaricidal activity of the ethyl acetate root extract of *S. italica* subsp. arachoides increased significantly ($P < 0.05$) with concentration when tested against *H. marginatum* rufipes. The potency of the extract persisted to the second day. The LC_{50} of the ethyl acetate root extract of *S. italica* subsp. arachoides in 24 h was 8.66% (w/v) while in 48 h was 3.59% (w/v) [17].

Leaves of six plants of species (*Aloe ferox, Aloe marllothii*, *Clerodendrum glabrum*, *Jatropta Curcas*, *Ricinus communis* and *Strychnos madagascariensis*) were extracted with organic solvents ranging from polar to non polar (methanol, acetone and dichloromethane). Infusions (soap-water-paraffin) and decoctions traditionally used were also prepared. The tick toxicity activities of extracts were evaluated against the livestock tick, *Rhipicephalus appendicuatus*. Organic extracts were not effective. Infusions of *A. ferox* and *S. madagascariensis* had strong topical and dipping application toxicity, infusions of *A. ferox* and *J.curcas* had a strong dipping toxicity effect [18]. The infusion of *Strychnos madagascariensis* had strong toxic effect against ticks. Since *S. madagascariensis* bears edible fruits, some of the toxic strychnine related alkaloids may be found spread in the leaves and played a role in giving the plant an activity [19,20]. Thus, results of the toxicity assays provide evidence for the efficacy of the traditional use of plants to control ticks.

The efficiency of the roots of *Dahlstedtia pentaphylla* (Taub.) Burk. (*Leguminosae*, *Papilionoideae*, Millettiae) plant was tested against infestations of *Boophilus microplus*. These tests were performed on 30 bovine animals, divided into three groups (control, extract diluted at 1:10 mL and extract diluted at 1:20 mL), after artificial infestation with some 4000 larvae/animal on days 21, 14, 7, 1 and 0. The extract of *D. pentaphylla* was obtained by dehydration, spraying and extraction in absolute ethanol, at a proportion of one part of root powder to three parts of ethanol, this being taken as standard (100%). This standard extract was then diluted in water at one part of extract to 10 and 20, for spraying on the bovines. The best result obtained (an efficiency rate of 76.10%) was seen 3 days after the application of the extract at a concentration of 1:10 mL. The extract showed no effect in inhibition of the laying or hatching of larvae on engorged females [21].

Hexane, diethyl ether, ethyl acetate and ethanol extracts from six wild plants of *Artemisia herba-alba, Artemisia monosperma, Euphorrbia aegyptiaca, Francoeuria crispa, Mesembryanthemus forsskalei and Reaumuria hirtella* were screened against the larvae of *Hyalomma dromedarii*. Petroleum ether, chloroform, ethyl acetate and ethanol extracts of plants *Peganum harmala* and *Silybum marianum* were also evaluated against the engorged females of *Boophilus annulatus*. Diethyl ether, ethyl acetate and ethanol extracts of *A. herba-alba* achieved the highest toxicity against the larvae of *H. dromedarii* followed by *A. monosperma* while hexane extract of *A. monosperma* gave the highest toxicity followed by *M. forsskalei* and *A. herba*-alba. Petroleum ether, chloroform and ethyl acetate extracts of *P. harmala* exhibited higher toxicity than *S. marianum* [22].

Water, methanol, petroleum and chloroform extracts, from *Tephrosia vogelii* plant have a toxic effect against various genera of ticks. Methnol extract indicated a significantly valuable yield than any of the other two solvents or water. All extracts killed 100% of the exposed ticks but variations were noted in the time taken to achieve 100% exposed tick death. Petroleum ether, chloroform, methanol and water extracts killed 100% of the ticks in an average time of 8.3, 9.7, 10.3 and 1.3 days, respectively [23]. This results are a good sign for the farmers that they can extract this plant (*Tephrosia vogelii*) with water and control ticks with it. This method is a good choice because it is available and not very expensive.

Acaricidal effect of eight aqueous herbal extracts against ixodid ticks, two extracts in goats and six in sheep were assessed. The leaves of *Clerodendron inerme* and *Croton bonplandianum* in goats could reduce infestation to 68.5 and 64.19 %, respectively on day 9. In sheep, the maximum reduction percentage recorded with the extract of flowers of *Tagetes erecta* was 30.08% on day 6 and with cloves of *Allium sativum*, 30.02 % on day 7 whereas maximum reduction percentage with the leaves of *Leucas aspera* was 29.52 % on day 8, *Parthenium hysterophorus*, 15.03 % on day 5, *Synadenium grantii* 11.57 % on day 4 and *Lantana camara* 3.47 % on day 1 post treatment. Early re-infestation of ticks is attributable to shorter residual effect of extracts [24].

Fernandes *et al.* [25] reported that the action of crude ethanol extract of the stem bark of the soapberry *Magonia pubescens* St. Hil. was studied upon larvae of the Brown

Dog tick *Rhipicephalus sanguineus* (Latreille). Mortality was observed after 48h exposure. All motionless larvae were considered to be dead. The extract of *M. pubescens* showed larvicidal potential against *R. sanguineus*. The lethal concentrations of 1503 ppm (LC_{50}) and 9991 ppm (LC_{99}) were obtained. There was no mortality in the control group. *M. pubescens* should be recognized as a future alternative acaricide for the control of Brown Dog tick.

Ribeiro *et al*. [26] reported that the crude methanolic extract of *H. polyanthemum* was toxic to the larvae at higher concentrations killing 100%, 96.7%% 84.7 and 52.7% at the concentrations of 50, 25, 12.5 and 6.25 mg/ml, respectively, after 48 h against *B. microplus*.

Moyo and Masika [27] found that, farmers in South Africa crushed the fresh leaves of *Aloe ferox* and *Ptaeroxylon obliquum*, soaked them in water overnight, strained the mixture and then sprayed the cattle infected with ticks. The majority of respondents used *A. ferox* (75%) and *P.obliquum* (25%) in the control of ticks.

Abduz Zahir *et al*., [28] determined the efficacies of acetone, chloroform, ethyl acetate, hexane and methanol dried leaf, flower and seed extracts of *Achyranthes aspera* L., *Anisomeles malabarica* (L.), *Gloriosa superba* L., *Psidium guajava* L., *Ricinus communis* L. and *Solanum trilobatum* L. tested against the larvae of cattle tick *Rhipicephalus (Boophilus) microplus* (Canestrini 1887). All plant extracts showed moderate effects after 24 h of exposure; however, the highest parasite mortality was found in the leaf ethyl acetate extract of *A. aspera*, leaf methanol extract of *A. malabarica*, flower methanol extract of *G. superba* and leaf methanol extract of *R. communis* against the larvae of *R. microplus*. The leaf ethyl acetate extract of *A. aspera*, leaf acetone and chloroform extract of *A. malabarica*, flower methanol extract of *G. superba* and leaf methanol extract of *R. communis* have the potential to be used as an eco-friendly approach for the control of the *R. microplus*.

The effects of medicinal plants are not restricted to direct exposure but also due to effects by its feeding by animals. Miller *et al*. [29] found that an attachment of *A. americanum* nymphs was reduced 39 and 33% on rabbits ingesting 5 and 10% snakeweed foliage diets, *Gutierrezia sarothrae* and *G. microcephala*, respectively. Adult ticks reared from engorged nymphs showed no treatment differences in survivability, engorgement weight or hatchability of egg masses.

The effects of aqueous root extracts of *Senna italica subsp.* arachoides on the feeding performance of adults of *Hyalomma marginatum rufipes* in three consecutive infestation of rabbits were studied under laboratory conditions. Ticks that infested the treatment rabbits fed poorly, taking significantly longer feeding periods ($P<0.05$) to acquire the blood meal and having significantly reduced engorgement weights ($P<0.05$) compared to those that fed on the control rabbits during the first and second infestations[30]. Abdel-Shafy *et al*. [31] used the *Jatroha curcas* seed meal (JCSM) in different levels (10 2.5, 5 and 7.5%) as acaricide in diet of rabbits experimentally infested by *Hyalomma marginatum marginatum*. Anti tick feeding gave the highest percentage (60-90%) of rejection which was recorded in 10% of JCSM group then the other treated groups (20-30%). Eggmass and reproductive index per female were markedly increased ($p<0.001$) in groups 2.5, 5 and 7.5% o JCSM.

Repellent Effects: Dautel [32] reported that the plant extract is considered a good repellent if it prevents a tick from contacting a host at all. Carroll *et al*. [33] said that to ascertain the effect of plant-based repellents, very few *in vitro* bioassays have been developed to test for tick repellency. So far there is no widely accepted standard procedure. This is a pity since different repellency bioassays produce contrasting results even when using the same tick species.

Kaaya [7] reported that *Pasture grasses* are capable of repelling, trapping and killing ticks. These grasses possess hairs (trichomes) that retard ticks from climbing to the top of the grasses in order to attach themselves to passing animals.

Stjernberg and Berglund [34] suggested that garlic *Allium sativum* may be considered as a tick repellent for individuals and populations at high risk for tick bites, rather than other repellent agents that might have adverse effects.

In a study to develop anti-tick pastures, the climbing behaviour of *R. appendiculatus* on *Melinis minutijlora* molasses grass was investigated. Experiments were conducted with cut green stems of grass, grass dried in the shade, grass dried in the sun, grass washed in solvent and grass growing in a study plot. In all cases a common pasture grass, *Pennisetum clandestinum* (Kikuyu grass), was used as control. All instars of the tick avoided climbing on the green *M. minutijlora* whereas most larvae, nymphs and adults climbed on the control green *P. clandestinum* grass. More ticks climbed on the stems that were dried in the sun than on air-dried grass. Acetone was found to be the best of five solvents used to extract the tick-repellent substance. Possibilities of using *M. minutijlora*, as part of an integrated tick control package are discussed [35].

The repellency of *B. microplus* larvae by the tropical legumes *Stylosanthes humilis and S. hamata* and identification of some of the chemical compounds present in both legumes were done [36]. The effect was evaluated by a repellency bioassay in an oflactometer using extracts from stems, leaves and whole plants treated with diverse organic solvents such as hexane, acetone, chloroform and methanol. The identification of chemical compounds was done by gas chromatography-mass spectrometry on whole plant extracts. This study demonstrated that both legumes had repellency properties. Repellency ranged from 68 to 92% in *S. humilis* and from 70 to 82% in *S. hamata*. Sixteen compounds were identified in *S. humilis*, with ferrocene and beta sitosterol being the most abundant (18.3 and 14% of the total, respectively). Seventeen compounds were identified in *S. hamata*, with linolenic acid being the highest relative abundance (17.6%). The compounds identified may be considered as potential candidates for explaining the repellency effects.

Mawela [18] said that the leaves of six plants of species (*Aloe ferox*, *Aloe marllothii*, *Clerodendrum glabrum*, *Jatropta Curcas*, *Ricinus communis* and *Strychnos madagascariensis*) were extracted with organic solvents ranging from polar to non polar (methanol, acetone and dichloromethane). Infusions (soap-water-paraffin) and decoctions traditionally used were also prepared. The tick repelling activities of extracts were evaluated against the livestock tick, *Rhipicephalus appendicuatus*. Acetone crude extracts of *A. ferox*, *A. marlothii* and *C. glabrum*; DCM extracts of *R. communis* and *A. marlothii* and MeOH extract of *J. curcas* repelled the ticks. Of all the aquaeous extracts, only the decoction of *S. madagascariensis* repelled ticks.

It may be that the volatile compounds present in organic extract are repellents and non-volatiles from aqueous extracts are toxic.

Plant-derived Compounds: Plant-derived compounds mean that either the main constituents were isolated from effective plants or commercial compound prepared from plants by private companies. The isolated active plant constituents and the commercial compounds were discussed according the acaricidal properties against ticks.

Chemical compounds used to control ticks simply by terminating their feeding process are classified as antifeedants [37]. Antifeedants are substances leading to temporary or permanent cessation of feeding when tasted by arthropods [38].

Deterrency and toxicity are the two main modes of action by which secondary plant compounds may act. Deterrents affect the peripheral nervous system and ultimately prevent the arthropod from further feeding whereas toxicants disrupt cellular, biochemical and physiological processes once digested by an insect [37].

Cadina-4,10 (15)-dien-3one was isolated from the leaves and stems of *Hyptis verticillata* collected from Jamaica. The compound disrupted the oviposition and hatching of *Boophilus microplus* eggs [39]. Moreover, Martin *et al.* [40] isolated 5 sesquiterpenoids, 4 flavonoids and p-coumarate ethyl from plants of *Polygonum pimctalnm*. They also assayed its acaricidal activity against *B. microplus*.

The herbal ectoparasiticide AV/EPP/14 (containing the active ingredients: *Cedrus deodare*, *Pongamia glabra* (*P. pinnata*\ *Azadirachta indica*, *Eucalyptus glubulus* and *Acorns calamus*) was effective against tick species [41-43].

Experimentally, the dilutions 1:2 and 1:4 of this drug with tap water eliminated all nymphs of *Rhipicephalus sanguineus* by both dilutions and reduced 98% and 90% of adults, respectively. In field trial, it reduced the number of ticks (93-95%) and (87-90%) at the dilutions 1:2 and 1:4, respectively. No adverse effects were observed [41].

Also, it was tested against the developmental stages and adults of *Hyalomma anatolicum anatolicum* by placing them on filter paper impregnated with a 1:4 dilution of the preparation. The average mortality of the unfed larvae, nymphs and adults was 100, 89.2 and 74 %, respectively. There was 100% inhibition of egg laying and hatchability in the engorged female ticks. When tested by spraying, 37 adult cattle that had natural infestations of *H. anatolicum anatolicum*, the preparation was 87.4 and 68.4% effective against nymphs and adults, respectively after 24 hours. Following a second spray application after 6 days, the infestation was almost completely eliminated. There were no adverse effects and no reinfestation for 16-20 days after treatment [42].

Additionally, ectoparasiticide AV/EPP/14 was assessed on 19 buffaloes and 8 cattle infested with *B. microplus*, *H. anatolicum anatolicum*, *H. marginatum isaaci* and *H. dromedarii* by spraying the compound in 1:4 dilution in tap water. Ticks infested buffaloes and cattle were sprayed five times at 6 day intervals (0, 6, 12, 18 and 24) which resulted in elimination of 65.3, 87.6, 96.5, 99.6 and 100% of the tick, respectively. The treated animals were free of tick for a period of 30 day after the last treatment [43].

The aqueous solutions of the natural compounds piquerols A and B (monoterpenes isolated from the plant *Piqueria trinervid*), at concentrations of 300 μg/ml, were found to have acaricidal potential on larvae and gravid females of *B. microplus*. However, neither compounds prevented oviposition. Piquerol A was observed to cause significant mortality in gravid female ticks [44].

The efficacy of Pestoban, a herbal preparation [containing extracts of *Cedrus deodar* a, *Azadirachta indica* and *Embelia ribes*] was studied against cattle ticks under field conditions at Nagpur, Maharashtra State, India [45]. Twenty-two cattle infested naturally with *B. microplus*, *R. haemaphysaloides* and *H. anatolicum anatolicum*, were selected for study. Amongst the various dilutions of Pestoban (1:5, 1:10, 1:20), 1:10 dilution was found to be 100, 80 and 70% effective against larvae, nymphs and adult stages, respectively. Treated animals were found to be free from tick infestations up to 7 days after the treatment. Pestoban had the advantages of good tolerance by the animals with no undesirable smell. No adverse reaction on any animal or the operator was detected.

Cardiac glycoside, digitoxin, from *Digitalis purpurea* L (Scrophlariaceae), a Cardiac glycosidal (cardendide) extract from *Calotropis procera* (Ait) R Br (Asclepiadaceae), were tested for their effects against larvae and adult stages of the camel tick, *Hyalomma dromedarii* by Al-Rajhy *et al*. [46]. They compared the results of the two Cardiac glycoside materials with several commercial acaricides. The results showed that the risks and benefits associated with the use of Cardiac glycosides are considerable. Toxicity of cardiac glycosides results from inhibition of the Na+/K+-ATPase.

In conclusion, the results from a lot of research work presented in this review article show that the medicinal plants extracts has the potential to be used as control agent for tick in farm animals.

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