

## Research Article

# Review on Traditional Medicinal Plant and its Extract Effect on Tick Control in Ethiopia

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**Abstract**

Tick infestation is one of the major economic problems in the production of livestock in Ethiopia. Ticks are the obligate parasite and belong to the suborder Ixodida, which contains a single super family, the Ixodoidea, which is divided into two major families, Argasidae (soft ticks) and Ixodidae (hard ticks), and the rare family Nuttalliellidae, with a single African species. The main tick genera found in domestic animals of Ethiopia are *Amblyomma*, *Hyalomma*, *Rhipicephalus*, and *Haemaphysalis*. Ticks bites can transmit the viral, bacterial and protozoal disease to livestock and also it can cause irritation to the livestock while biting. Tick can be controlled by applying the acaricid especially organophosphates, amidines and synthetipyrithroids, chlorinated hydrocarbons and arsenicals and ivermectin which are expensive to buy. However, Ethnoveterinary practices may provide very good alternatives since they are cheap and easily accessible and It can replace modern practices especially for those folks living in remote rural areas where modern veterinary service is scant. Several plants have been shown to possess anti-tick, insecticidal, growth inhibiting, antimoulting and repellent activities. The chemical which act as acaricide and repellents are present in leaves, stem, root fruit and seed of this all above plants. Andalso, the combination of juice, powder or latex of plant can be used for controlling of tick. The chemical which extract from plant act as acaricide are like alkaloid calpurmenin, catechol tannins aponins, sugars, leuco-anthocyanins, polyterpenes, and sterols. The plant which act as the killing, repellent effect to ticks in Ethiopia are like *Azadirachta indica*, *Phytolacca dodecandra*, *Calpurnia aurea*, *Milletia ferruginea*, *Tephrosia vogelz*, *Euphorbia abyssinica*, *Cucumis prophetarum*, *Parathem'um hysterophoms*, *Syadenium grantiz*, *Lantana camara*, *Silenemacroserene*, *Grewia ferruginea* and others. In conclusion, the plant which found in Ethiopia are source of chemical that can inhibit the tick and other insects. The chemical extracted from stem, leaves, bark, seed and root can be applied on to the surface of livestock at tick infested area and it can kill or repel the ticks. The objective of this review is just to know the plant species which can act as acaricide, repellent and larvicidal effect on ticks. To overview the chemical constituent and extraction of plant which used to production of modern acaricide in the future industry.

**Keywords**

- Ethiopia
- Ethnoveterinary
- Acaricide
- Tick
- Repellent
- Traditional medicinal plant

**INTRODUCTION**

In Ethiopia, tick infestation is one of the most important causes of huge economic loss when infest livestock [1]. Ticks are within a member called the phylum (Arthropoda), class (Arachnida), sub class (Acari) and Order (Parasitiformes) [2]. Within the Parasitiformes, ticks belong to the suborder Ixodida, which contains a single superfamily, the Ixodoidea, which is divided into two major families, Argasidae (soft ticks) and Ixodidae (hard ticks), and the rare family Nuttalliellidae, with a single African species [3]. The family Ixodidae, or hard ticks, contains some 683 species [4]. As adults, Ixodids exhibit prominent sexual dimorphism: the scutum covers the entire dorsum in males, but in females and immatures the scutum is reduced to a small podonotal shield behind the capitulum, thereby permitting great distention of the idiosomal integument during feeding [5].

Ixodidae ticks are relatively large and comprise thirteen genera. Seven of these genera contain species of veterinary and medical importance: *Amblyomma*, *Rhipicephalus*, *Haemaphysalis*, *Hyalomma*, *Dermacentor* and *Ixodes* [3]. The family Argasidae, or soft ticks, consists of about 185 species worldwide and have one important genus that infests cattle, *Ornithodoros* [6]. Adult argasids lack a dorsal sclerotized plate or scutum, their integumentis leathery and wrinkled, their mouthparts are not visible from above, and they show no obvious sexual dimorphism. Argasidae are wandering ticks, which only remain on their host while feeding [7]. Tick bites, in addition to causing irritation have been implicated in the transmission of viral, rickettsial, bacterial and protozoal diseases affecting wild, domestic animals and humans. And also, tick infestation can cause the different grade lesion on the live stocks skin and hide [10,11]. They also parasites such as screw worm flies and infection by pathogens like *Dermat-*

*ophilus congolensis* and other bacterial diseases predispose animals to secondary attacks from other [11].

The aim of tick control campaign is not to control all ticks simultaneously, but a definite species because of its particular role [8]. The successful implementation of rational and sustainable tick control programmes in grazing animals is dependent upon a sound knowledge of the ecology or epidemiology of the tick as it interacts with the host in specific climatic, management and production environments. In most situations, however, efficient and reliable methods for the control of cattle ticks and TBD are based on the use of a chemical treatment (acaricide application), often without a local understanding of appropriate ecology or epidemiology [9]. Ticks are controlled by application of acaricide especially organophosphates, amidines and synthetic pyrethroids, chlorinated hydrocarbons and arsenicals [12].

Although the use of acaricides for the control of ticks has limitations and tick resistance to acaricides is an increasing problem and real economic threat to the livestock worldwide, most livestock holders depend completely on acaricides to control ticks, but do not have access to guidelines on how to make a profit from their tick control program or how to detect and resolve problems with resistance to acaricides [13]. In this review the traditional medicinal plant have been used by Ethiopian farmer in order to control tick infestation, however farmers do not know the chemical constituent of medicinal plants. Therefore, Ethnoveterinary practices may provide very good alternatives how to use and the chemical constituent of plants. And also, Ethnoveterinary practice provides the cheap and easily accessible, replaceable modern practices especially for those folks living in remote rural areas where modern veterinary service is scant [14]. Ethiopia is endowed with a diverse biological resource including about 6, 500 species of higher plants, with approximately 12% endemic, hence making it one of the six plant biodiversity rich regions [15]. Out of these plants, more than 62.5% of the forest areas are found in southwest region of Ethiopia [16], where most of the medicinal plants are confined and have been used as a source of traditional medicine to treat different human and livestock ailments [17-19].

The ethno-veterinary and medical knowledge offers a range of herbs to be evaluated for their insecticidal and acaricidal properties. The acaricidal activity of several species of plants has been evaluated against different kinds of ticks, and in some cases, the secondary metabolites responsible for the acaricidal activity occurring in different species of plants or even in different parts of some species of plant (leaves, stems, rind, roots, etc.) have been identified. Species of the families Lamiaceae, Fabaceae, Asteraceae, Piperaceae, Verbenaceae and Poaceae have been the most studied to determine the effectiveness of their essential oils, extracts or their respective secondary metabolites on different species of ticks [20].

A number of reports are available on the effect of different extracts of plant material on tick species [21, 22]. Several plants have been shown to possess anti-tick, insecticidal, growth inhibiting, antimoulting and repellent activities [23]. And also, the significance of traditional medicinal plant extraction chemical acts as acaricide and repellent effect on the tick. Most of the treatments were from trees, compared to shrubs and herbs. Stems and

bark were the most used plant parts when compared to leaves and roots, fruits, sap, and branches [24].

Some plant which act as the killing, repellent effect to ticks in Ethiopia are like *Azadirachta indica*, *Phytolacca dodecandra*, *Calpurnia aurea*, *Milletia ferruginea*, *Tephrosia vogelz*, *Euphorbia abyssinica*, *Cucumis prophetarum*, *Parathem'um hysterophoms*, *Syadenium grantiz*, *Lanana camara*, *Silene macroserene*, *Croton bonplandr'anum*, *Grewia ferruginea* [25]. Therefore, the objective of this paper is to review on the most common traditional control of tick in Ethiopia by using medicinal plant extract. To know the chemical constituent of plant which act as larvicidal, acaricidal to control tick infestation in livestock.

## LITERATURE REVIEW

### Traditional medicinal plant used for control tick

Research on plants for use in tick control has been developed in an attempt to find extracts with acaricidal properties that can be used in association with or even as replacements for synthetic compounds. One advantage from the use of those compounds is that resistance develops slowly because there is usually a mixture of different active agents with different mechanisms of action [26]. This review reveals that how the traditional medicinal plant is prepared and application to control tick. Therefore, most of the treatments were solutions prepared by boiling plant parts and then administering the solution to the animal orally and topically. In general, the application is depend on the types of tick whether one host range or two host range or three host and also the stage of tick lifecycles. Topical applications were used for skin conditions and mashes and decoctions for internal ailments. The most common method of preparation was often boiling or soaking the plant in water. This allows time for the active ingredients to infuse into the water, thus detaching the chemicals and making the solution potent [27]. Latexes of *Euphorbia obovalifolia* and *Ficus brachypoda*, juice of crushed leaves of *Phytolacca dodecandra* and *Vernonia amygdalina*, fruit juice of *Solanum incanum*, crushed seeds of *Lepidium sativum* mixed with fresh cattle faeces, juice of crushed leaves and bark of *Calpurnia aurea* and commercially available spice of *Capsicum spp.* mixed with butter, were used by peasant farmers to control ticks. Preliminary in vitro efficacy tests of these plant preparations were performed on engorged female *Rhi. (B).decoloratus*. Preparations of *Capsicum spp.*, *E. obovalifolia*, *S. incanum* and *F. brachypoda* were found to have 30–100 % killing effects [28].

### Main traditional medicinal plants used for tick control in Ethiopia

**Calpurnia aurea:** *Calpurnia aurea*, a member of the subfamily Papilionoideae of the family Fabaceae [29]. It is a small, multi-stemmed tree, 3–4 m tall, occurring widespread in bushland and grassland in sub-Saharan Africa and India. It is often found in overgrazed areas and is easily cultivated [30,31]. *Calpurnia aurea* is known as *cheka* in Afan Oromo and the juice of crushed leaves and bark of *calpurnia aurea* used for tick control Ethiopia [28]. The main pharmacologically active compounds of *C. aurea* may be the alkaloid calpurmenin and its 13 $\alpha$ -(2'-pyrrolicarboxylic acid) ester [32]. The chemical extract from this plant acts as attractant/repellent and acaricidal effects of *C. aurea* extracts [33].

**Tephrosia:** *Tephrosia* is a genus of leguminous shrubby plants and herbs and mostly found in tropical countries, The herb comes in various species that include *Tephrosia virginiana* (L.) pers. (Fabaceae), *Tephrosia purpurea*, *Tephrosia candida*, *Tephrosia vogelii* and *Tephrosia toxicaria*. The rotenone is the chemical responsible for the pesticidal property of *T. vogelii* [34]. The phytochemical screening of the leafy stem's powder of *Tephrosia vogelii* revealed the presence of catechol tannins, saponins, sugars, leuco-anthocyanins, polyterpenes, and sterols and ethanolic extract of the leafy stems of *Tephrosia vogelii* can against *Rhipicephalus sanguineus* larvae [35]. In vitro acaricidal activity of ethanol extract of leafy stem of *Tephrosia vogelii* act as larvicidal potential due to the chemical composition of *Tephrosia vogelii*. The phytochemical screening performed revealed the presence of catechol tannins, saponins, reducing compounds (sugars), leuco-anthocyanins, and sterols-polyterpenes which have biocidal properties [35].

The combined action of tannin and saponin may be responsible for the larvicidal activity on the larvae of *Rhipicephalus (Boophilus) microplus* which observed in vitro [36]. Cattle sprayed with this extract had a residual protection period from re-infestation by ticks for 10 days [37].

**Azadirachta indica:** *Azadirachta indica* is a small to medium-sized tree, usually evergreen, up to 15 (30 max.) m tall, with a round, large crown up to 10 (20 max.) m in diameter; branches spreading; bole branchless for up to 7.5 m, up to 90 cm in diameter, sometimes fluted at base; bark moderately thick, with small, scattered tubercles, deeply fissured and flaking in old trees, dark grey outside and reddish inside, with colourless, sticky foe [38]. Extract from bark of *Azadirachta indica* can against adult female ticks of *Boophilus microplus* and *B. annulatus*. And this plant has a severe effect on the reproductive physiology and mortalities the female ticks [39,40].

The neem tree (*Azadirachta indica*), of Asian origin, contains around 135 described compounds that can have action against arthropods, including the limonoids (tetranortriterpenoids), termed globally as azadirachtin. Among these, azadirachtin A (AZA), commonly referred to as azadirachtin [41-43]. The fruits of neem tree contain the highest amounts of azadirachtin [44]. Azadirachtin has been shown to have inhibitory effect on vitellogenin during oogenesis of arthropods and acceleration of the hatching rate and mortality of *Hyalomma anatolicum*, *H. excavatum* newly hatched larvae [44,45].

**Stylosanthes:** Several tropical pasture legumes of the genus *Stylosanthes*, as *S. scabra*, *S. viscosa* and *S. guaianensis*, have anti-tick effects. The stems and leaves of these legumes are covered with glandular trichomes, which produce a sticky secretion with a characteristic odour. Tick larvae trying to ascend the plants to await a passing host are trapped and killed in the secretion [46,47]. The anti-tick effects of the tropical legumes *Stylosanthes humilis* produce viscous fluids that poison and kill ticks [48]. Chemical compounds which extracted from whole plants from tropical legumes *Stylosanthes humilis* and *Stylosante shamata* are listed as follows:

Naphthalene, Hexadecanoic acid, Hexadecanoic acid, Hexadecanoic acid, ethyl ester, Linolenic acid, methyl ester

,Tricosane,2,4-Bis (dimethylbenzyl) phenol,2,4-Bis (dimethylbenzyl) 6-t-butylphenol, Eneicosane, Gammasitosterol, Octadecenami,Delta.8tetrahydrocannabinol, Retinoic acid, methyl ester, Betasitosterol, Ferrocene, 11(acetylthio)undecil, Eicosane and 1,2 -Benzenedecarboxylic acid, Hexadecanoic acid, methyl ester, Hexadecanoic acid, ethyl ester,2,6Bis(tbutyl)4(dimethylbenzyl)9,12-Octadecadienoic acid, Linolenic acid, methyl ester, Steric acid, methyl ester, Tetratriacontane, Docosane, 7-hexyl, Pentacosane, Eicosane, Linolenic acid, ethyl ester, Tetracosane 2,4-Bis(dimethylbenzyl)-6-t-butylph,[49].

**Senna italic:** *Senna italica*, the Port Royal senna, Italian senna, or Senegal senna is a legume tree in the genus *Senna*. It is recognized by many other common names based on the regions it grows in. In India, it is used to produce a powder used to treat hair which is known as "neutral henna". There are 3 subspecies of this plant based on the size of the inflorescence and the length of the petiole. The subspecies are *Sennaitalica*, *micrantha*, and *arachoides*. In many regions, this plant is cultivated commercially and medicinally [50].

The anti-tick properties of the root extract of *Sennaitalica subsp. arachoides* against the adults of *Hyalomma marginatum*, the chemical which excreted from root of *Senna italica* are hexane, chloroform, dichloromethane, ethyl acetate and methanol. Out of these chemicals only ethyl acetate extracts proved to be potent against adults of *H. marginatum*. The acaricidal activity of the ethyl acetate root extract of *S. italica subsp. arachoides* increased significantly with concentration when tested against *H. marginatum*. As research revealed that root of *Senna italica* has the following chemicals such as the hexane, chloroform, dichloromethane, ethyl acetate and methanol extracts tested. However, only ethyl acetate extracts proved to be potent against adults of *H. marginatum*. 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*. The potency of the extract persisted to the second day. The LC50 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) [51].

### Preparation and administration mode of this traditional medicinal plant

*Calpurnia aurea* extracts are used in Ethiopia to protect stock against ticks. Acetone, hexane and water leaf extracts of *C. aurea* collected in Ethiopia were tested for repellent/attractant and acaricidal properties on unfed adult *Rhipicephalus pulchellus* ticks. In contrast to many other plant species evaluated, *C. aurea* extracts did not have repellent properties, but rather had a slight attractant capacity. With 20% and 10% acetone extracts, all ticks were either killed or their mobility severely compromised after 1 $\mu$ l of extract was topically applied on the abdomen. At a 5% concentration, 85% of ticks were still affected [52].

The preparation of *calpurnea aurea* for control of tick by extraction of chemical from leave, bark and juice of crushed leaves and bark of *Calpurnea aurea* applying on the topical at tick infested surface of animals [28]. Chemical investigations of *Calpurnia aurea* have resulted in the isolation of a series of alkaloids, phenolic compounds, flavonoids, flavonols, and proanthocyanidins, which also founds in the genus *Calpurnia* [53]. Two novel



alkaloids 3 $\beta$ , 4 $\alpha$ , 13 $\alpha$ -trihydroxylupanine and 3 $\beta$ , 4 $\alpha$ -dihydroxy 13 $\alpha$ -O-(2'-pyrrolylcarbonyl)-lupanine 16(calpaurine) have been isolated from the leaves of Ethiopian *Calpurnia aurea*ssp. *aurea*. Two minor quinolizidine alkaloids, 4 $\beta$ -hydroxy-13 $\alpha$ -O-(2'-pyrrolylcarbonyl)-lupanine (digittine) and 4 $\beta$ , 13 $\alpha$ -dihydroxylupanine have also included in the list. Furthermore, lupinine and epilupinine, calpurmenine and calpurmenine pyrrolicarboxylic acid ester (previously found in subsp. *sylvaticus* but not in subsp. *aurea*) have been isolated together with 13-hydroxylupanine, its tiglate and pyrrolicarboxylic acid esters (calpurnine), virgiline and virgiline pyrrolicarboxylic acid ester [53].

*Tephrosia vogelii* plant materials were collected from two selected sites, one on a higher altitude than the other. The air-dry plant material was crushed into powder; and extracted with a known volume of solvent. The mixture was left to stand for seven days with daily stirring for at least 2 h. Extracts from shoot, cortex and roots have an average yield of 0.06, 0.05 and 0.015 g per one gram of plant raw material, respectively. Shoot and cortex plant parts accumulate relatively high amounts of the active ingredients in *Tephrosia* compared to the roots; probably explaining why leaves (shoot) are preferred by the local farmers for effective pest control. Methanol, Petroleum ether and Chloroform yield 0.0875, 0.0142 and 0.0172 g per one gram of plant raw material, respectively, indicating a significantly valuable yield when methanol is used for extraction 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; implying that ticks are more susceptible to the active ingredient extracted using petroleum ether relative to the other solvents [54]. So that, the chemical extracted from *Tephrosia vogelii* apply on topical surface of animal by spraying, then the tick can be killed by this chemicals. First the leaves of *Azadirachta indica* is chopped and soaked in sufficient quantity of distilled water in plastic buckets (up to 10 lit/bucket) and were vigorously shaken after every 24 hour. After a period of 30 days, contents buckets were heated at 25-30 °C till 10% of the total volume was achieved. Material was then sieved and extract was stored at 4 °C for further use. Water extract prepared from leaves of *A. indica*, used to evaluate anti-tick activity of plants against 12-14 days old larvae of *Rhipicephalus microplus* [55]. Extracts were prepared from leaf, bark, and seed of *Azadirachta indica*. The efficacy of the neem seed extracts was compared with the commonly used synthetic pyrethroids, and comparable efficacy against *Rhipicephalus spps* fed on animals treated with neem seed extracts and acaricide treated was noted [56]. In generally, the preparation of chemicals extract from the traditional medicinal plants is from root, seed, leave and bark of plant in form of juice, powder and latex.

## CONCLUSION

Ticks cause great economic losses to livestock, and adversely affect livestock hosts in several ways. Loss of blood is a direct effect of ticks acting as potential vector for haemo-protozoa and helminth parasites. Blood sucking by large numbers of ticks causes reduction in live weight and anemia among domestic animals, while their bites also reduce the quality of hides. In controlling of

ticks the cost of acaricide is very expensive and not easily available at remote rural area. Traditional medicinal plants have advantage of greatly reducing costs of treatments and have a minimal environmental impact, making footbath a sustainable and replicable method, adoptable in Ethiopia. The plants which have been reported as the source of acaricide mostly found in Ethiopia are like *Calpurnia aurea*, *Tephrosia vogelii*, *Azadirachta indica*, *Stylosanthes spp*s, *Senna italic*. The chemical which act as acaricide by killing, repellent and larvacidal effect are found in the leave, root, seed and bark of the above mentioned plants. The chemical extraction of traditional medicinal plants may applied to animals by in-vitro and spraying on the skin of animals. In developing country this traditional medicinal plant is the most effective, cheap and ever farmer can prepare the chemical extraction at home where the veterinary clinic is scant.

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