Ticks infestation on Cattle in Ethiopia

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Abstract: Ticks are obligate blood feeding ecto parasites of vertebrates and induce huge production loss in livestock industry and creating serious public health problems in the world. Ethiopia is believed to have the largest livestock population in Africa. This livestock sector has been contributing considerable portion to the economy of the country and still promising to rally round the economic development of the country. In Ethiopia livestock production remains crucial and represents a major asset among resource-poor small holder farmers by providing milk, meat, skin, manure and traction force. However it has been estimated that about 80% of the world population of cattle are infested with ticks. Ticks have considerable impact on animals either by inflecting direct damage or by transmission of tick borne diseases. Tick borne haemo parasitic diseases of ruminants such as *Anaplasmosis, Babesiosis* and *The*ileriosis remain most important in tropical countries. Tick and tick born disease affect 90% of the world's cattle population and are widely distributed throughout the world. The country's environmental condition and vegetation are highly conducive for ticks and tick- borne disease perpetuation. The objective of this seminar paper is to review the epidemiology, diagnosis pathogenesis, treatment and control options of Ticks on Cattle.
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1. Introduction

Ethiopia is believed to have the largest livestock population in Africa. This livestock sector has been contributing considerable portion to the economy of the country and still promising to rally round the economic development of the country. In Ethiopia livestock production remains crucial and represents a major asset among resource-poor small holder farmers by providing milk, meat, skin, manure and traction force. (Nejash *et al.,* 2016). It has been estimated that about 80% of the world population of cattle are infested with ticks (Wasihun and Doda 2013). Ticks have considerable impact on animals either by inflecting direct damage or by transmission of tick borne diseases. Tick and tick born disease affect 90% of the world's cattle population and are widely distributed throughout the world (Belayneh and Bogale, 2016). The country's environmental condition and vegetation are highly conducive for ticks and tick-borne disease perpetuation (Nejash and Tilahun, 2016).

The presence of diseases caused by haemo parasites is broadly related to the presence and distribution of their vectors. Ticks are more prevalent in warmer climates, especially in tropical and sub-tropical areas (Ikpeze *et al.,* 2015). Ticks are considered to be most important to health of domestic animal in Ethiopia comprise *Amblyomma, Rhipicephalus, Haemaphysalis, Hyalomma* and *genus Rhipicephalus (Boophilus).* The genus *Amblyomma* and *Rhipicephalus (Boophilus)* are predominating in many parts of country (Eyod *et al.,* 2015). Tick borne haemo parasitic diseases of ruminants such as *Anaplasmosis, Babesiosis* and *The*ileriosis remain most important in tropical countries. The effects of ticks estimated annual loss of US$ 500,000 from hide and skin downgrading and approximately 65.5% of major defects of hides in Eastern Ethiopia (Desalegn *et al.,* 2015). The country's environmental condition and vegetation are highly conducive (favorable) for ticks and tick-borne disease perpetuation (Rahmeto *et al.,* 2010). There is a direct relationship between concentration of the drug and degree of resistance. A strain controlled by one dose of a drug may show resistance when a lower concentration of the same drug is administered (Abbasa *et al.,* 2014).

The Ethno veterinary and Medical knowledge offers arrange of herbs to be evaluated for their insecticidal and acaricidal properties. The ingredient of these plants and herbs are known to possess insecticidal, growth-inhibiting and anti-molting repellent activities (Salwa, M. Habeeb, 2010). The prolonged or incorrect use of tick chemicals can lead to resistance in ticks, enabling the ticks to tolerate and survive chemical applications. Resistance depends on the chemical group used and its rate of application over time (Kearney, 2013). Plant-based repellents against ticks (Acari: Ixodoidea), which derived chemicals that kill or repel ticks are extracted from various parts of the plant, including the flowers, fruits, leaves, seeds standardized methods are needed to assess resistance evolution and allow the comparison of resistance data between laboratories. As highlighted in the guidelines of the FAO, a suitable laboratory test for acaricide resistance needs to satisfy several requirements (FAO, 2004). In Ethiopia, ticks in cattle causes serious economic loss to small holder farmers, the tanning industry and the country as a whole through mortality of animals, decreased production, down grading and rejection of skin and hide (Alemu *et al.,* 2014). Studies on the seasonal dynamics and acaricide resistance patterns are scanty in Ethiopia.

2. Literature Review

2.1 Ecology of ticks

Tick distribution and their population vary according to their adaptability to ecology, eco-climate, microhabitats, ambient temperature, rainfall and relative humidity which is critical factors affecting life cycle of ticks. The relative humidity on the other hand remains an important factor for survival of ticks by regulating the water balance and prevents dehydrations (Tadesse *et al.,* 2012).

2.2 Taxonomy of ticks

Ticks are classified under the class Arachnida, Order Acarina, suborder Ixodidae, families Ixodidae and Argasidae which are distributed worldwide. Ticks are members of the same phylum (Arthropoda) of the animal kingdom as insects, but are in different classes (class Insecta includes Flies, Fleas and Lice, but class Arachinida includes Mites and Ticks). The subphylum Chelicerata includes the class Arachnida, which again contains several subclasses. The subclass Acari (syn. Acaria, Acarina, Acarida) includes ticks. There are two well established families of ticks, the Ixodidae (hard ticks) and Argasidae (has hard scutum, male and female easy distinguished, collects on the host, each parasitic stages feed only one times, sexual dimorphism is marked, can mate on the host except Ixodes spp, mouthparts are visible and has one nymphal stage) or soft ticks (no scutum, male and female not easy distinguished, mostly not collected on the host,) nymphs and adults feed many times, sexual dimorphism not marked, has several nymphal stage active throughout the year and has long life time. Family Ixodidae (hard ticks) contains (684) species under many genera. These include Amblyomma (102 species), Boophilus (5 species) Dermacentor (30 species) Haemaphysalis (155 species) Hyalomma (30 species), Ixodes (254 species) and Rhipicephalus (70 species) (Abadllah, S. H. I.1999).

The Ixodidae (hard ticks) and Argasidae (soft ticks) both have sharing certain basic properities; they differed in many structures, behavioral, physiological, feeding and reproduction pattern. Ticks that are considered to be most important to domestic animals' health in Africa comprise about seven genera and forty species. Among these tick genera, the main ticks found in Ethiopia are *Ambylomma* (40%), *Boophilus* (21%), *Heamaphysalis* (0.5%), *Haylomma* (1.5%), and *Rhipicephalus* (37%), *A. varigatum* and *B. decoloratus* are most important and widely distributed in Ethiopia (Wasihun and Doda*,* 2013).

2.2.1 Ixodidae (hard ticks)

There are three active stages in the life cycle of a hard tick: larvae, nymphs and adult ticks. Each instar takes a blood meal only once and long periods are spent on vegetation between blood meals. Most ticks require three different hosts to complete one full cycle. These three-host ticks detach on completion of feeding, drop from the host, molt and wait for another host. However, in some tick species, the engorged larvae remain on the host, where they molt rapidly to become nymphs, continue to feed and then drop as engorged nymphs. These two-host ticks include *Rhipicephalus evertsi. evertsi* and some *Hyalomma* species. In one-host ticks, the nymphs also remain on the same host and continue to feed as adults. *Boophilus* spp. are typical one-host ticks. After the female drops from the host, she seeks a sheltered place for oviposition, where she lays a single batch of several thousand eggs and then dies. Males usually remain much longer on the host, where they may mate repeatedly (Moges *et al.,* 2012).

2.2.2 Argasidae

The life cycle and feeding pattern of the soft ticks are different from those of the hard ticks. The Argasidae are multi-host ticks; there are several nymph stages and the adults also feed repeatedly. Feeding can last from a few minutes to hours, or even days for the larvae of some species. Most argasid ticks live in nests or burrows, although there are exceptions. Adults usually mate in the nest or burrow. Mated females take small, repeated blood meals to support the production of small batches of eggs. The occurrence of several nymph instars and frequent adult blood meals contributes to an unusually long life span (several years) and high resistance to starvation. These species are extremely hardy and can survive in hot, dry conditions for long periods without a blood meal. Argasid ticks also concentrate their blood meal by eliminating excess water via the coxal apparatus, which is located in the proximal part of the front pair of legs. There are approximately 170 species of soft ticks. Species of medical or veterinary importance belong to the genera Argas, Ornithodoros and Otobius (Abebe *et al.,* 2010).

2.3 Identifying Cattle Ticks

All three parasitic stages are generally present on infested cattle, but the easiest to identify is the adult stage. Cattle ticks are the only ticks with all legs that are a pale cream in color (Walker *et al.,* 1970). The Amblyomma ticks are ornate, large and broad. They have a long gnathosoma with basis Capituli rectangular dorsally. Eyes and festoons are present (Walker *et al.,* 2003).

2.4 Tick distribution and Problems in Ethiopia

Most ticks distributed in tropical and subtropical areas of the country (in Ethiopia). In Ethiopia the main tick genera found in cattle are *Amblyomma, Hyalomma, Rhipicephalus, Haemaphysalis* and *genus Rhipicephalus (Boophilus).* In Ethiopia *Boophilus* ticks are prevalence in Gima, Gofa, and also the highland areas of Harare and Dire Dawa (Fentahun and Mohamed, 2012). Tticks could be affecting directly and indirectly cattle, especially Bos Taurus (exotic breeds) more susceptible than Bos Indicus (local breeds or zebu). Cattle ticks may transmit the organisms that cause tick fever and a serious blood parasite disease of cattle. This disease can be lethal to susceptible animals. Others may suffer a severe loss of condition. The hides of infested cattle are damaged by tick bites and their value is reduced. The conventional method of controlling tick infestations in Ethiopia is application of acaricide, either by hand spraying or by hand dressing. Therefore to minimize tick adverse effect appropriate and timely strategic control measures are crucial, (Nejash, 2016).

2.5 **Biology of ticks**

Ticks are among the most significant blood-sucking arthropods and distributed worldwide. They transmit various pathogens that can cause disease and death in cattle. Ticks have several morphologic features and physiologic mechanisms that facilitate host selection, ingestion of vertebrate blood, mating, survival and reproduction. Although the natural history of ticks varies considerably among species, these arthropods are well-adapted to survive in tropical, temperate, and even subarctic habitats. Most ticks require three different hosts to complete one full cycle. These three-host ticks detach on completion of feeding, drop from the host, molt and wait for another host. The life cycle of tick involves according to feeding habitat and characteristic number of host individuals (Tadesse *et al.,* 2012).

In the hard ticks mating takes place on the host, except with Ixodes where it may also occur when the ticks are still on the vegetation. Male ticks remain on the host and will attempt to mate with many females where as they are feeding. The lifecycle of ticks (both Ixodids and Argasids) undergo four stages in their development; eggs, 6-legged larva, 8-legged nymph and adult. According to the numbers of hosts, Ixodids ticks are classified as one-host ticks, two-host ticks, three-host ticks and Argasids classified as multi-host ticks. In one-host ticks, all the parasitic stages (larva, nymph and adult) are on the same hosts; in two- host ticks, larva attach to one host, feed and molt to nymph stage and engorged, after which they detach and molt on the ground to adult; and in three-host ticks, the larva, nymph and adult attach to different hosts and all detach from the host after engorging, and molt on the ground. In multi-host ticks (Argasids), a large number of hosts are involved and it is common to have five molts, each completed after engorging and detaching from the hosts (Moges *et al.,* 2013).

2.6 Host finding

All ticks spend most of their life cycle away from their hosts (without host), hiding either in soil and vegetation or in the nests of their hosts. So they need to be able to find hosts on which to feed. Ticks do this in several ways. Many ticks have the eggs and molting stages in soil or vegetation in the environment in which their hosts graze or hunt (Abdela *et al.,* 2016). 7

2.6.1. One-host tick

One-host ticks parasitize large hosts mainly bovines and equines. Once the larva finds a suitable host, feeding and molting proceed sequentially on the same host until the adult stage is reached. This type of life cycle is characteristic of Boophilus species (Abdela *et* al., 2016).

2.6.2. Two-host tick

In these species, the larval and nymph stages are spent on the same animal, but the nymph drops off to molt to the adult stage, which then seeks a final host. E.g. A few species in the genera *Hyalomma* and *Rhipicephalus (*Abdela *et al.,* 2016).

2.6.3. Three-host tick

In these species, the larvae, nymphs, and adult females feed on different host individuals. Larvae and nymphs detach and fall to the ground before molting to the next stage and searching for a new host (Abdela *et* al., 2016).

2.7 Epidemiology of ticks

2.7.1 Host relationship

Some ticks live in open environments and crawl onto vegetation to wait for their hosts to pass. This is a type of ambush and the behavior of waiting on vegetation is called questing. Thus in general such as *Rhipicephalus, Haemaphysalis* and *Ixodes* the larvae, nymphs and adults will quest on vegetation. The tick grabs onto the host using their front legs and crawl over the skin to find a suitable place to attach and feed. Adult tick of genera *Ambylomma* and *Hyalomma* are active hunters, they run across the ground after nearby hosts (Abdela *et al.,* 2016).

2.8 Pathogenic effects of ticks and tick-borne diseases

Infested cattle lose condition due to 'tick worry' and loss of blood. Heavy infestations can kill calves and even adult cattle. Animals in poor condition are especially vulnerable (susceptible). Previously unexposed cattle become heavily infested until they build up a degree of resistance. *Bosindicus* (tropical breeds of cattle) and their crosses, develop a greater degree of resistance than *Bostaurus* (British and

European breeds of cattle (Tiki and Addis, 2011). Cattle ticks transmit the organisms that cause tick fever, which is a serious blood parasite disease of cattle. It also lower the reproductive & productive efficiency of their hosts. Economic loss through morbidity & mortality of animal hosts and control cost. Hides of infested cattle are damaged by tick bites, reducing their value. In severe cases the hides may be unsalable (Tiki and Addis, 2011). Especially ticks with long mouthparts cause considerable direct damage to hides of cattle. Secondary infections can cause septic wounds or abscesses, and lesions on the teats of cows may affect milk production. Ticks also have adverse effect on livestock in several ways and parasitize a wide range of vertebrate hosts and transmit a wide variety of pathogenic agents than any other group of arthropod (Abdela, 2016).

2.8.1 Direct effect of ticks

Ticks are responsible for direct damage to livestock through their feeding habits. The damage is manifested as hide damage, damage to udders, teats and scrotum, myiasis due to infestation of damaged sites by maggots and secondary microbial infection. Ticks bite can directly debilitating to domestic animals, causing mechanical damage, irritation, inflammation and hypersensitivity (Tiki and Addis, 2011). Feeding by large numbers of ticks causes reduction in live weight and anemia among domestic animals, while tick bites also reduce the quality of hides. Apart from irritation or anemia in case of heavy infestations, tick can cause severe dermatitis. These parasites generate direct effects in cattle in terms of milk production and reduce weight gain (Tiki and Addis, 2011).

2.8.2 Physical effect of ticks

Ticks are attached to the body for a blood meal and may cause irritation and serious physical damages to livestock. Included tick worry, irritation, unrest and weight loss due to massive infestation of ticks. The direct injury to hides due to tick bites, loss of blood due to the feeding of ticks. When cattle are heavily infested, ticks can be found anywhere on the body of animals (Sitotaw *et al.,* 2014).

2.8.3 Vector of pathogens.

Ticks can be carrier of pathogens, which they transmit from host to host during blood sucking and cause a large variety of diseases (Sitotaw *et al.,* 2014). Most of pathogenic haemo parasites are:-

2.8.3.1 Babesiosis

Bovine Babesiosis is caused by the intraerythrocytic protozoan parasites of the genus Babesia. The major species of Babesia which causes bovine Babesiosis and includes *B. bovis, B. bigemina*, *B. divergens* and *B. major*. Babesia parasites can be transmitted transovarially between tick generations in the case of Ixodes, surviving up to 4 years without a vertebrate host. *Babesia* may also be transmitted by fomites and mechanical vectors contaminated by infected (Sitotaw, 2014). Bovine Babesiosis causes most serious economic loss to the livestock industry, endangering half a billion cattle across the world. Babesiosis, especially in cattle has great economic importance, because unlike many other parasitic diseases, it affects adults more severely than young cattle, leading to direct losses through death and the restriction of movement of animals by quarantine laws (Nejash and Kula, 2016).

2.8.3.2 Anaplasmosis

Anaplasmosis, formerly known as gall sickness, traditionally refers to a disease of ruminants caused by intraerythrocytic organisms of the order the genus Anaplasma. Anaplasmosis is a vector borne infectious blood disease in cattle caused by the rickettsial parasites. It is not contagious, but umerous species of tick vectors (Boophilus, Dermacenter, Rhipicephalus, Ixodes and Hyalomma) can transmit Anaplasma species (Demessie and Derso, 2015). It causes outbreaks in a herd, which can lead to the death of adult cattle. Other economic losses include abortions, decreased weight gain, bull infertility and treatment costs. Although many outbreaks of anaplasmosis occur in the spring and summer, they can occur at any time of the year (Sitotaw *et al.,* 2014).

2.8.3.3 Theileriosis

Theileriosis results from infection with protozoa in the genus Theileria of the suborder Piroplasmorina. Theileria species are obligate intracellular parasites. Theileria is considered to be spread by bush ticks and/or introduction of infected animals from an endemic area. It may also be spread via standard husbandry practices that include blood transfer (such as using needles on multiple animals) and across the placenta. Bush ticks only transfer Theileria to cattle, not other species (Nejash and Tilahun, 2016).

2.8.4 Tick-bite paralysis

It is characterized by an acute ascending flaccid motor paralysis caused by the injection of a toxin by certain ticks while feeding. Examples are paralysis caused by the feeding of *Dermacentor andersoni***,** sweating sickness caused by *Hyalomma truncatum*, tick toxicosis caused by *Rhipicephalus species* and other tick paralysis caused by *Ixodes holocylus* (*Tiki and Addis, 2011).* Effective diagnosis of tick borne hemoparasitic diseases of ruminants is helpful to implement appropriate prevention and control strategies. Tick control, chemoprophylaxis and immuno-prophylaxis are the basic methods to control tick borne hemoparasitic diseases of ruminants, (Desalegn *et al.,* 2015). Housing in tick proof buildings, Separate housing of cattle from others, Quarantine, Pasture spelling and rotational grazing, Manual removal of ticks, Clearance of vegetation, Use of acaricides, Use of biological control methods (e.g. birds, rodents, shrews, ants and spiders play some role in tick control measures), Breeding cattle for tick resistance, Ethno veterinary practices against ticks (e.g. Several plants and herbs have been shown to possess anti-tick insecticidal, growth inhibiting, anti-molting and repellent activity and Tick vaccine (Torina *et al.,* 2014).

2.9 Control methods

2.9.1 Biological control methods of ticks

Ticks have numerous natural enemies, but only a few species have been evaluated as tick bio-control agents. Some laboratory results suggest that several bacteria are pathogenic to ticks, but their mode of action and their potential value as bio-control agents remain to be determined (Muhammad *et al.,* 2008). Natural enemies of ticks include insectivorous birds, parasitoid wasps, nematodes, *Bacillus thuringiensis* bacteria, and deuteromycete fungi (largely *Metarhizium anisopliae* and *Beauvaria bassiana)* (Latif, A.A. and Walker, A.R. 2004). The potential of each of these taxa as bio-control agents will be discussed in turn. Mammals and birds typically consume ticks during self-grooming. For example, laboratory studies demonstrate that significant numbers of larval black legged ticks are consumed by white-footed mice (Latif, A.A. and Walker, A.R. 2004)

2.9.2 Tick vaccine

Tick infestations affect animal health and production worldwide, both for the impact on animal weight gain and milk production and for the pathogens transmitted by these ecto-parasites. Acaricides are a major component of integrated tick control strategies, but their application had limited efficacy in reducing tick infestations and often accompanied by serious drawbacks, it includes the selection of acaricide-resistant ticks, environmental contamination and contamination of milk and meat products with drug residues. All of these issues reinforce the need for alternative approaches to control tick infestations and pathogen transmission that is the use of vaccines (a vaccine which is prepared from infected ticks) with tick antigens (Torina *et al.;* 2014).

2.9.3 Breeding cattle for tick resistance

Although some of the observed variation in natural tick resistance is related to environmental factors and significant component of variation in natural disease resistance appears to be genetic origin. Several studies have been conducted on genetic determination of tick resistance. Tick resistance has been shown to be heritable reported a heritability estimate of 34% for tick resistance, indicating that genetic improvement through selection should be effective. Resistance of cattle to tick infestation was reported to consist of innate and acquired components (Nejash *et al.,* 2016).

2. 9.4 Stock breeding and pasture management.

Cattle breeds indigenous to Africa, typically Bos Indicus or zebu have a good heritable ability to acquire natural resistance to the feeding of ticks. This characteristic can be used in breeding programmed to produce crosses with more productive exotic cattle of the Bos Taurus type which will give good resistance to ticks and good production (Torina *et al.;* 2014).

2.9.5 Application of chemicals methods

The use of acaricides in the control of ticks has improved the viability of cattle farming in the tick infested areas. Ticks can be killed by dipping or spraying cattle with an appropriate chemicals (acaricides). Ticks can develop resistance to acaricides (Tadesse *et al.,* 2012).

2.9.5.1 Dipping

In this method, animals are immersed in a dipping tub containing solution of chemicals. Infested cattle should be dipped in the organophosphate acaricide coumaphos (0.3% active ingredient. In general dipping vats provide a highly effective method of treating animals with acaricides for tick control (Tadesse *et al.,* 2012).

2.9.5.2 Spray

The application of fluid acaricides to an animal by means of a spray has many advantages and has been successfully practiced for controlling ticks on most of the animals (Barnett, 1961). Spraying equipment is highly portable, and only small amounts of acaricides need to be mixed for a single application. However, spraying is generally less efficient in controlling ticks than immersion in a dipping vat because of problems associated with applying the acaricides thoroughly on all parts of the animal body (Tadesse *et al.,* 2012).

2.9.5.3 Spot treatment or hand dressing

There are predilections sites for certain tick species on part of the body which are not effectively treated by spray or dips. The inner parts of the ear, under part of the tail, the tail brush and the areas between the teats and the legs in cattle with large udder are especially liable to escape treatment. The application of insecticides with aerosols and in oils, smears, and dusts by hand to limited body areas is time-consuming and laborious, but in certain instances it may be more effective and economical (in terms of cost) of acaricides than treating the entire animal (Tadesse *et al.,* 2012).

2.9.5.4 The future of tick control in the communal areas

Indigenous Sanga and Zebu cattle which are predominantly reared by communal farmers have a high degree of tick and tick-borne disease resistance and require minimal tick control methods. This tick control method is suitable and cost effective (minimize) for usages, even farmers (Nejash *et al.,* 2016).

3. Conclusion

Ticks are an important limiting factor for cattle production and causes several economic losses due to morbidity and mortality and there by contributing to loss hide and wool productivity of sheep industry in Ethiopia. Ticks are among the most significant blood-sucking arthropods and distributed worldwide. They transmit various pathogens that can cause disease and death in cattle. Ticks have several morphologic features and physiologic mechanisms that facilitate host selection, ingestion of vertebrate blood, mating, survival and reproduction. Although the natural history of ticks varies considerably among species, these arthropods are well-adapted to survive in tropical, temperate, and even subarctic habitats. Most ticks require three different hosts to complete one full cycle. These three-host ticks detach on completion of feeding, drop from the host, molt and wait for another host. The life cycle of tick involves according to feeding habitat and characteristic number of host individuals.

Based on the above conclusion, the following recommendations are forwarded:

❖ Improving of the veterinary service and infrastructure in prevalence area with provision of acaricide treatment.

❖ Regular applications of acaricides on animals, communal grazing area and housing.

❖ To create awareness to the farmers about the control methods and effect of ticks on cattle.

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References

1. Abadllah, S. H. I. (1999). Ticks and tick-borne diseases o cattle and sheep in North Darfur State, Sudan.
2. Abebe, R., Fentahun, T., Abera, M. and Bekele, J. (2010). Survey of ticks (Acari: Ixodidae) infesting Cattle in two districts of Somali Regional State, Ethiopia. Veterinary World, 3(12):539-543.
3. DEMESSIE, Y. ANDDERSO, S. 2015. Tickborne hemoparasitic diseases of ruminants: A review, advances in Biological Research 9 (4): 210-224, 2015.
4. Desalegn, T., Fikru, A. and Kasaye, S. (2015). Survey of tick infestation in domestic ruminants of Haramaya District, Eastern Hararghe, Ethiopia. Desalegn et al., J Bacterial Parasitol, 6:5.
5. FAO (Food and Agriculture Organization), 2004. Resistance Management and Integrated Parasite Control in Ruminants-Guidelines, Module 1-Ticks: Acaricide Resistance: Diagnosis, Management and Prevention. Food and Agriculture Organization, Animal Production and Health Division, Rome, pp. 25–77.
6. Fentahun, B. and Mohamed, A. (2012). Survey on the distribution of tick tpecies in and around Assosa Town, Ethiopia. Research Journal of Veterinary Science, 5: 32-41.
7. Ikpeze, O. O., Eneanya, C. I. and Onyido, A. E. burden, seasonality, sex ratio and preferred sites of ticks of public health importance on cattle found at amansea, anambra state nigeria.
8. Kearney S. (2013). Principal Livestock Regulatory Officer, Darwin. Acaricide (Chemical) Resistance in Cattle ticks.
9. Latif, A. A. & Walker, A. R. (2004). An introduction to the biology and control of ticks in Africa.
10. Lees, K., Jones, A. K., Matsuda, K., Akamatsu, M., Sattelle, D. B., Woods, D. J., Bowman, A. S., 2013. Functional characterisation of a nicotinic acetyl-choline receptor alpha subunit from the brown dog tick, Rhipicephalussanguineus. Int. J. Parasitol. 44, 75–81.
11. Moges, N., Bogale. and Fentahun. (2012). Hard Ticks (Ixodidae): Species Composition, Seasonal Dynamics and Body Site Distribution on Cattle in Chilga District, Northwest Ethiopia.
12. Asian Journal of Agricultural Sciences 4(5): 341-345, 2012.
13. Muhammad, G., Naureen, A., Firyal, S. And Saqib, M. (2008). Tick Control Strategies in Dairy Production Medicine. Pakistan Vet. J. Ndhlovu, D.N., Makaya, P.V. and Penzhorn, B.L. (2009). Tick infestation, and udder and teat damage in selected cattle herds of Matabeleland South, Zimbabwe. Onderstepoort Journal of Veterinary Research, 76:235–248.
14. Nejash and Tilahun (2016). Epidemiology and Control of Bovine Theileriosis in Ethiopia: Review. Journal of Medicine, Physiology and Biophysics. An International Peer-reviewed Journal Vol.23.
15. Nejash, A. A. (2016). Reviewof Economically Important Cattle Tick and Its Control in Ethiopia. 25
16. Salwa, M. Habeeb, (2010). Etho veterinary and Medical knowledge of crude plant extracts and

its methods of application (traditional and modern) for tick control. World applied science. Journal 11(9); 1047-1054.

17. Tadesse, F., Abadfaji, G., Girma, S., kumsa, B. and Tariku Jibat, T. (2012). Identification of tick species and their preferred site on cattle's body in and around Mizan Teferi, Southwestern Ethiopia. Journal of Veterinary Medicine and Animal Health, 4(1), pp. 1-5.
18. Tiki, B. and Addis, M. (2011). Distribution of Ixodid Ticks on Cattle in and Around Holeta Town, Global Veterinaria 7 (6): 527-531.
19. Torina, A., Moreno-Cid J. A., Blanda, V., Mera I. G. F., Lastra J. M. P., Scimeca S., Blanda M., Scariano M. E., Disclafani S. B. R., Piazza A., Vicente J., Gortázar Ch., Caracappa. S., Lelli R. C. and Fuente J. (2014). Control of tick infestations and pathogen prevalence in cattle and sheep farms vaccinated with the recombinant Subolesin-Major Surface Protein 1a chimeric antigen. Torina *et* al.; licensee BioMed Central Ltd.
20. Walker, A. R., (2003): Ticks of domestic animals in Africa: A guide to identification of species, Bioscience report, Pp 1-221.
21. Walker, J. B. (1970). Notes on the Common Tick Species of East Africa. 3rd Edn. Cooper, McDougall and Robertson, Nairobi, Pp: 23. 18. Samish, M., Ginsberg, H. and Glazer, I. (2004). Biological control of ticks, Parasitology, 129 Suppl: S389-403.
22. Wasihun, P. and Doda, d. (2013). Study on prevalence and identification of ticks in Humbo district, Southern Nations, Nationalities, and People's Region (SNNPR), Ethiopia. Journal of Veterinary Medicine and Animal Health 5(3), pp. 73-80, March 2013.

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