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ORIGINAL ARTICLE

A Review of Tick and Tick Control Strategies in Pakistan

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ABSTRACT

Background: In Pakistan, ticks are a major problem for livestock and humans. These can spread a wide range of infections including protozoan, viruses, and bacteria such as spirochetes and rickettsiae. Ticks are found in all ecological and geographic zones of Pakistan. Bovine Babesiosis and Theileriosis have been documented in Pakistan. Crimean-Congo hemorrhagic fever (CCHF) is a tick-borne viral disease that affects those who work with cattle, like slaughterhouse workers, vets, and hospitals. There are at least 40 tick species, mostly Haemaphysalis, Hyalomma, and Rhipicephalus. In Pakistan, CCHF is spread by Hyalomma ticks, posing a severe risk to human health. Ticks are most prevalent in the summer (June–September) and goats rather than sheep in Pakistan. Tick-borne infections include Anaplasma, Babesia, and Theileria spp., more common in sheep than goats. In the previous sixteen years, occasional CCHF outbreaks have been documented in Pakistan, with a 24% fatality rate. Mass tick control efforts have been initiated in Punjab and Sind provinces to control tick populations and zoonotic disease spread. These tick control campaigns use a lot of Deltamethrin and Ivermectin. Deltamethrin and Ivermectin can harm the ecosystem and suggested alternate tick control approaches. Deltamethrin can damage the kidneys of insect-eating birds and disrupt the life cycle of aquatic organisms when mixed with stream water. This is because roughly 60%-80% of the whole dose is excreted by the animal and is not metabolized by the animal. Dung deterioration can be hampered by a reduction of dung beetles. Tick control methods have been used for decades worldwide. But only chemical technique is still practised in Pakistan. Each method's efficacy varies with tick number, dispersion, morphology, and host species.

Results: The goal of the literature review was to discuss ticks and tick management measures used on domestic animals in Pakistan and offer new and successful techniques. This article reviews the most widely used tick management methods in Pakistan. According to studies, ticks and tick-borne diseases cause significant economic losses to livestock globally. Chemicals (acaricides) are overused to treat ticks on domestic and wild animals. Tickbots, bait boxes, vaccines, natural fauna, and bio-pesticides should be promoted and used to control ticks.

Conclusion: The literature concluded that tick and tick-borne diseases are a significant cause of economic losses to the livestock throughout the globe. The chemicals (acaricides) are excessively applied against ticks on domestic and wild animals. Other new techniques like tickbot, bait boxes, the discovery of vaccines, natural fauna and biopesticides should be promoted and applied to control the ticks. These strategies will have an extreme outcome on reducing the tick population.

Keywords: Ticks, Ectoparasites, Congo Haemorrhagic Fever, Wild animals, Integrated tick management, Pakistan

INTRODUCTION

Ticks are ectoparasites of domesticated and wild animals all over the world mainly tropical and subtropical areas, including Pakistan. These are vector of several viral, protozoal, rickettsial and bacterial diseases (Jongejan and Uilenberg, 1994). These diseases can spread directly and indirectly to humans, animals, birds and wild fauna (Ramzan et al., 2021). Among viral infections, Congo Haemorrhagic Fever (CHF) is the primary health problem in Pakistan. The maximum virus cases with the maximum case-fatality rate was reported in 2014 throughout Pakistan. The overview of agents and vectors are given in table 1 (Ghosh et al., 2007). There is a need to control tick and tick-borne diseases in Pakistan using different management approaches.

Distribution: Ticks have spread worldwide, mainly in tropical and subtropical areas. These have been reported from Europe, Australia, Asia, Africa, South and North America (Reye et al., 2012; Razmi and Ramoon, 2012; Singh and Rath, 2013; Ramzan et al., 2019; 2020).

Economic importance of ticks: The livestock industry plays a crucial role in Pakistan by providing various products such as protein, milk, meat and wool. These are the main source of income for poor people in Pakistan. Tick infestation has an adverse effects on humans, animals and

the environment. These arthropods suck blood from various body parts of humans and animals. These transmit the various pathogens during feeding, which become the cause of diseases resulting in reducing milk, meat and wool production. These cause harmful effects on animals through the depression of the immune system, blood loss, irritation and general stress, damage to skins, and hide (Ghosh et al., 2007; Garcia, 2003; Biswas, 2003). Kabir et al (2011) reported that the epidemiology of ticks and Tick-Borne Diseases (TBDs) is increasing with the change in environment, resulting high economic losses of livestocks worldwide. It has been estimated that global financial losses cause by tick infestation is US$14000-18000 million while US$ 498.7 million per year are used to control ticks and TBDs in livestock industry of India and Pakistan (Minjauw and McLeod, 2003).

Reported species and infestation rate in Pakistan: According to Ramzan et al. (2021), 53 tick species belonging to different genera were collected by various researchers and identified throughout Pakistan. The rate of infestation of each species varies according to host and location (Manan et al., 2007). A study was performed to check the tick prevalence on sheep and goats and resulted in 41.53 and 43.37 % prevalence on goats and sheep, respectively (Irshad et al., 2010). Ali et al (2013) had investigated 70 and 34% tick prevalence on cows and buffaloes, respectively. According to Manan et al. (2007), the infestation rate of genera Boophilus, Rhipicephalus, Amblyomma and Hyalomma on buffaloes was 43.40, 16.88, 3.05 and 36.65%, respectively while Khan et al. (1993) had reported 14.7 and 28.2% infestation rate in buffaloes and cows, respectively. Genus Hyalomma had recorded a significant number of livestock compared to other genera.

Host-contact patterns of tick species: A variety of host-contact patterns of tick had recorded. They complete their life cycle on one, two and three hosts (Montales et al., 2016). Boophilus microplus and Dermacentor albipictus are one host tick species, each developmental stage such as adult, nymph and larva complete their life cycle on the same host individual while two and three host tick species (Rhipicephalus sanguineus, Dermacentor variabilis and Hyalomma anatolicum anatolicum) used different individuals for adult, nymph and larva life stages (Anderson and Magnarelli, 2008; Estrada-Peña, 2015).

Preferable body sites of animal for tick infestation or attack: Tick can access their host by using odours, breath, host movement and sensing body heat (Ramzan et al., 2018; 2019). The preferable sites for tick infestation were reported ear, udder, tail, testes,

Reasons for tick infestation or a high population of ticks in Pakistan: The tick can spread due to various reasons such as migration of animals from an infested area to non-infested areas or regions of the country, introducing alien species, Urbanization, tourism and loss of biodiversity. The chances of tick infestation can increase with the import or export of animals. The main factors involved in tick spreading are climate change, land use, water availability, favourable environmental condition and physiographic parts of Pakistan (Ramzan et al., 2021).

Control strategies in Pakistan: Several control strategies are applied to control ticks on domestic animals such as cattle, buffaloes, sheep and goats (Piesman and Eisen 2008, Eisen and Dolan 2016). The following strategies or measures are recommended to control tick infestation on domestic animals:

Cultural Control:

Construction of tick proof buildings: The sheds of cattle and buffaloes (crossbred and exotic animals) should be constructed tick proof. The exotic and crossbred cattle have been more susceptible to TTBDs than native livestock. The cracks and crevices on the walls of animal farms should be filled with cement. The filling of these cracks and crevices is an inexpensive measure which can reduce the tick burden at some extent.

Removal of waste materials from farms: The pile of animal dung and collection or stacks of bricks present in the farms are the leading breeding site for tick. These heaps of animal dung and bricks should be removed from animal sheds on a daily basis. Removing these things from sheds can reduce the risk of tick infestation.

Burn waste materials near the shed walls to kill the tick stages: The crack and crevices are the egg-laying sites of ticks and hidden places of larva, nymphs and adults during day time, especially in winter. The burning of waste materials near the walls of animal sheds can effectively kill the tick stages, resulting in reduced tick infestation (Ramzan et al., 2018).

Separate shed of animals, especially cows and buffaloes: The separate shed of each animal, especially exotic and native can effectively reduce the tick infestation or prevalence. It has been reported that mixed animals carry more tick than native animals. Ticks are species-specific such as cattle ticks cannot attack buffaloes if both animals are kept in separate farms or sheds (Lemcke, 1997). It has been reported that buffaloes carry cattle ticks under stressful conditions and on the same farm.

Quarantine: The newly purchased animals could be kept separate from already present animals in the shed. The animals having ticks on their bodies should be treated with acaricides before mixing with already existing animals.

Pasture spelling and rotational grazing: The rotational grazing and pasture spelling can prove helpful in decreasing the tick population. David (2005) reported that the change reduces the maximum population of ticks in grazing. The rotational grazing and pasture spelling have reduced the one host Ixodid tick population but are ineffective against multi-host Ixodid ticks (David, 2005). The rotational grazing and pasture spelling can give the best result against ticks in developed countries, including Australia, while this strategy is rarely used in New Zealand. The ranges and pastures are mostly public regarding ownership in developing countries like Pakistan, so this tick control strategy (pasture spelling) is not of much value.

Manual removal of ticks: The manual removal of ticks from the animal body early can significantly reduce the tick infestation. This approach can apply at the small scale where the population of livestock is low. The herdsman can remove the ticks from infested animals during milking using forefingers. The collected ticks were killed by putting on the fire (Muhammad, 1994). The precautionary measures should be carefully followed during ticks removal. Sometimes, the ticks' blood can spread pathogens or become the cause of diseases such as Lyme diseases and

CCHF. Such diseases transmission cases have been reported from many countries, including Pakistan (Athar et al., 2005; Jamil et al., 2005). OIE (2004) has said that herders crush ticks between the fingers, which is the main threat for disease transmission.

Clearance of vegetation: Several tick species had been collected and reported from vegetation. Such species are present on the blades of grass in wait of host called questing. The proper clearance of grasses and other tick preferable sites can reduce tick infestation at some level. The questing ticks can be controlled by tickbot (Gaff et al. 2015; Mays et al. 2016).

Bait boxes: The rodents also carry ticks and become the source of pathogens in dairy farms. The control of rodents and ticks on their body with bait boxes can prove the the best strategy. These baits could be installed in the sheds to minimize tick population (Ostfeld 2010; Dolan et al. 2004; Dolan et al. 2017).

Chemical Control: The several formulations of acaricides have been applied to kill the ectoparasites of livestock (Rodriguez-Vivas et al. 2014a). These are systemic and direct contact poisons spread to domestic and wild animals in different formulations like emulsifiable concentrate (EC) and wettable powder (WP). The insect growth regulator/acarine can affect the nervous system of ticks (Taylor 2001) and proved the best approach to control the maximum pest population. These chemicals are applied on cattle by using different sprayers like bucket-pump hand sprayersrs (Kinsey, 1993) orm of pher,omones, even dipping the animals in ponds treated with acaricides (Geoal et al. 2004).

The harmful effects of the dipping method have been reported by many researchers. The proper checking of any wound on an animal body is essential before dipping animals in treated pond otherwise acaricides cause toxicity and become the cause of various skin diseases. The thirsty, exhausted and week or less than 6 months animals could not be dipped. The ponds should be neat and clean from organic matter like animal dung before treated with acaricides otherwise, minimize the toxicity of acaricides, and more concentration of acaricides can be used. Two attendants can do this operation, and proper safety measures should be followed. The appropriate dimension of the dipping tank or pond should be defined. The dipping approach has not yet been tested in Pakistan due to lack of facilities. This is an expensive strategy and used against a large population of livestock.

The acaricides belonging to groups; chlordimeform, formamidines, chloromethiuron and clenpyrin are mostly tested against ticks (George et al., 2004). Ivermectin, Neguvon (Bayer, Germany), Ecofleece (Prix, Pharma), deltamethrin 2.5% (Selmore, Pharma), Cypermethrin 10 EC (Sawa-Ag) and Cyprin 20EC (Pameer, Pharma) have used against tick species in many countries including Pakistan. These chemicals have given effective results and reduced tick infestations (Nolan et al., 1981).

Adverse effect of chemical applications: Acaricides have proved the best approach in controlling tick population and cause resistance and environmental pollution. Martins and Furlong (2001) had reported Ivermectin resistance.

Future Prospects/Recommendations: The literature review showed that ticks are the major health issue for humans and animals throughout the world, especially in Pakistan. The new management techniques such as genetically engineered and subunit vaccines, crude vaccines, endosymbionts of ticks, macrocyclic lactones, plant-based chemicals like Lavendula augustifolia, Gynandropsis gynandra, Azadirachta indica, Cymbopogon spp., Pelargonium roseum and their derivative compounds (azadirachtin, citronellal, linalool, carvacrol and geraniol) should be introduced and promoted in Pakistan. These are eco-friendly and have shown 90–100% efficacy and repellency against tick in various countries. Comparable to those of currently used acaricides. Several active compounds such as azadirachtin, carvacrol, linalool, geraniol and citronellal have been isolated. The biological agents such as bacteria (Bacillus thuringiensis), Turkeys (Meleagris gallopavo), birds, fungi (Metarhizium anisopliae and Beauvaria bassiana), nematodes and parasitoids wasps (Ixodiphagus hookeri) should be promoted against ticks.

Table 1: Summary of vector-borne diseases transmitted by ticks

Diseases (Agents)	Vectors
Bacterial and rickettsial diseases	
African tick bite fever (Rickettsia africae)	Amblyomma spp.
Boutonneuse fever (Rickettsia conorii)	Rhipicephalus spp., Haemaphysalis spp., Amblyomma spp.
Tularemia (Francisella tularensis)	Amblyomma americanum, Ixodes spp., Dermacentor spp., Chrysops spp.
Rocky Mountain spotted fever (Rickettsia rickettsii)	Dermacentor spp., Rhipicephalus spp., Amblyomma spp.
North Asian (Siberian) tick typhus (Rickettsia sibirica)	Hyalomma asiaticum, Dermacentor spp.
Tick-borne lymphadenopathy (Rickettsia slovaca)	Dermacentor spp.
Tidewater spotted fever (Rickettsia parkeri)	Amblyomma maculatum
Lyme disease (Borrelia burgdorferi)	Ixodes spp.
Tick-borne relapsing fever (Borrelia duttonii)	Ornithodoros spp.
Human monocytic ehrlichiosis (Ehrlichia chaffeensis)	Amblyomma americanum
Human granulocytic ehrlichiosis (Ehrlichia ewingii)	Amblyomma americanum
Human granulocytic anaplasmosis (Anaplasma phagocytophilum)	Ixodes spp.
Protozoan diseases	
Babesiosis (Babesia spp.)	Boophilus microplus, Haemaphysalis sp., Rhipicephalus sanguineus, Hyalomma sp., Ixodes spp.
Viral diseases	
Powassan virus	Dermacentor spp., Ixodes spp., Haemaphysalis spp.
Colorado tick fever	Dermacentor andersoni
Kyasanur Forest disease	Haemaphysalis spinigera
Tick-borne encephalitis virus	Ixodes persulcatus, I. ricinus
Crimean-Congo hemorrhagic fever	Hyalomma spp.

Ghosh et al. (2007)

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