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Estimation of acaricide resistance in *Boophilus microplus* ticks of different agro-climatic zones of Thrissur, Kerala

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Abstract

Ticks and the diseases they transmit pose a notable threat to livestock farming globally. The tick species *Boophilus microplus* was collected from ten different agricultural climatic regions in the Thrissur district of Kerala. In each area, thirty heavily engorged female ticks were randomly sampled from ten dairy cows, and their resistance to insecticides was evaluated using the larval packet method. A substantial number of resistance cases were noted particularly for pyrethrins and azadirachtin compounds. Phosphine-31 was identified as a chemical compound, with a numerical value of 48.01. Additionally, it was calculated that among 100 samples tested, 2% exhibited resistance to chlorpyrifos, cyromazine, and dimethoate pesticides individually. Risk factors were determined to be statistically significant at $p<0$. The analysis revealed that exposure to acaricidal treatments aimed at *B. microplus* has accelerated the development of drug-resistant arthropod pests, influenced by livestock management practices.

Keywords: *Boophilus microplus*, pyrethrins, chlorpyrifos, resistance

Introduction

There are approximately 928 known tick species (Murrell, 2022) [6]. Among the identified types, five from the Argasidae family and seven from the Ixodidae family are particularly important for cattle (Muhammad *et al.*, 2021) [5]. In regions where *Boophilus* species are prevalent, control measures are implemented through strategic treatments based on seasonal timing, infestation levels in individual animals, and the proportion of affected livestock (Qayyum *et al.*, 2020) [10].

The reliance on chemical methods for tick control has resulted in resistant strains of *Boophilus microplus* emerging over recent years (Guerrero *et al.*, 2021) [4]. This study aimed to assess how widespread resistant strains of *B. microplus* are against pyrethroids, amidines, and organophosphorus compounds using the larval packet method while examining contributing factors in ten distinct areas with varying climates and farming practices within Thrissur district.

Materials and Methods

Samples were sourced from ten diverse agro-climatic zones in Thrissur district, Kerala. Thirty fully-fed female ticks of *B. microplus* were selected from ten randomly chosen cattle (Rodríguez *et al.*, 2020) [2]. These ticks were housed in small bottles with ventilation holes to maintain moisture through damp cotton swabs. Acaricide resistance was assessed via the larval packet test (LPT), established by Davey (1962) [1], with samples undergoing testing thrice.

Fully-fed ticks were placed into petri dishes stored in darkness at a temperature range of 27±2 °C with relative humidity maintained at 80-90% to facilitate egg-laying. The eggs were subsequently transferred into glass vials covered with cotton under identical temperature and humidity conditions for larval hatching. Resistance was evaluated by comparing outcomes against discriminating doses used for sensitive strains: cypermethrin (0.05%), deltamethrin (0.09%), flumethrin (0.01%) for pyrethroids; amitraz (0.0002%) for amidines; clorpyrifos (0.02%), coumaphos (0.02%), diazinon (0.08%) for organophosphorus compounds (Ortiz, 1966) [8].

Larval mortality was recorded after 24 hours post-treatment; a mortality rate of 99.9% indicated a discriminating dose. To investigate risk factors associated with resistant ticks, surveys among livestock farmers collected data regarding frequency of dip usage for tick control, product rotation schedules, types and dosages of chemicals applied, cattle breeds raised, and pasture types on their farms.
Prevalence calculations utilized this formula:

Prevalence % = (Number of farms with resistant ticks/Total number of farms surveyed)

The influence of various risk factors—including product rotation frequency, formulation type used, genetic breed considerations of cattle, and pasture type—was analyzed through contingency tables structured as either 2x2 or 3x2 based on significance levels set at $p<0.05$ (SAS, 2002) [12].

Results and Discussion

Resistance among *B. microplus* strains was observed across all acaricide categories tested. For amidines like amitraz resistance ranged between larval mortalities of approximately 13% to nearly 83%. Resistance rates concerning pyrethroids such as flumethrin varied from zero up to about 92%, while deltamethrin showed a mortality range between around eight to nearly ninety-four percent; cypermethrin's rates varied similarly from approximately twelve percent to around ninety-five percent respectively.
In terms of organophosphorus compounds like clorpyrifos registered resistance at approximately thirty-one percent; coumaphos exhibited up to forty-eight percent resistance; diazinon reached an eighty-two percent maximum mortality range indicating strong evidence that parasites can adapt against chemical controls used within ruminant populations (Fragoso *et al.*, 2020) [2].
Farmers who replaced their products every three-to-four years often cited ineffectiveness as reasoning behind their changes due primarily to diminished efficacy in controlling ticks over time—a finding supported by research conducted by Neri *et al.*, (2021) [7] and George *et al.*, (2021) [3] which indicates repeated use or heightened dosages can contribute significantly towards developing treatment resistance.
Acaricide applications occurred via two primary methods: spraying encompassed fifty-two point five percent while pour-on methods accounted for forty-seven point five percent overall prevalence detected appeared higher amongst spray applications (P = 0.007). This could be attributed to insufficient solution volume—only two liters being utilized per adult animal—which Pound *et al.* (2021) [9] recommend should ideally be increased within four-to-eight liter range per adult bovine ensuring thorough coverage is achieved.

Table 1: Acaricide Resistance Analysis

Acaricide Constituent	Larval Mortality Range (%)	Positive Cases	Negative Cases
Organophosphorus			
Clorpyrifos	26-99	21	45
Coumaphos	29-100	32	35
Diazinon	15-100	55	16
Pyrethroids			
Flumethrin	0-92	62	0
Deltamethrin	8-93	64	0
Cypermethrin	13-95	59	1
Amidines			
Amitraz	15-89%	63	0

Conclusion

The findings indicate that resistance development among *B. microplus* towards acaricides poses serious challenges undermining effectiveness associated with chemical control strategies employed currently within farming contexts today. Factors related specifically towards chemical application management alongside specific cattle breeds actively contributed toward fostering these resistances observed.

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