

Molecular epidemiology of *Babesia* species, *Theileria parva*, and *Anaplasma marginale* infecting cattle and the tick control malpractices in Central and Eastern Uganda

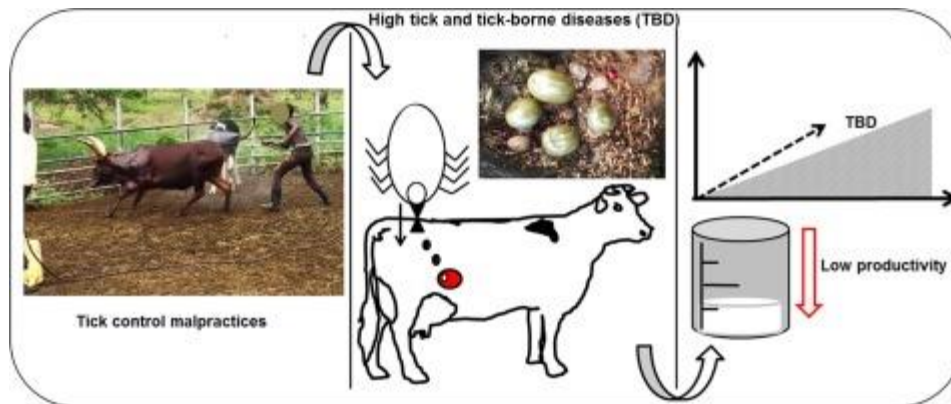
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Abstract

East Coast fever, babesiosis, and anaplasmosis are the major tick-borne diseases affecting cattle productivity in Uganda. The emergence of acaricide-resistant ticks is suspected to have caused a rise in hemoparasites. This study sought to detect and characterize hemoparasites among farms in acaricide-failure hotspots of central as compared to the acaricide-failure naïve areas in Eastern Uganda. Nested PCR assays were performed to determine the prevalences of *Babesia bovis*, *Babesia bigemina*, *Theileria parva*, and *Anaplasma marginale* in cattle blood samples sourced from randomly selected farms. Randomly selected isolates were sequenced to determine the genetic diversity of the parasites using the following marker genes: *B. bovis* spherical body protein 4, *B. bigemina* rhoptry-associated protein 1a, *T. parva* 104 kDa microneme-rhoptry antigen, and *A. marginale* major surface protein 5. Furthermore, partially and fully engorged adult ticks were collected for taxonomy, and tick-control practices were assessed using a semi-structured questionnaire. The prevalence of *B. bigemina*, *T. parva*, and *A. marginale* in cattle were 17.2, 65.1, and 22.0%, and 10.0, 26.5, and 3% in the central and eastern region, respectively. Whilst, *B. bovis* was not detected in the farms involved. The sequences for *B. bigemina*, *T. parva*, and *A. marginale* from the central region showed 99% identity with those from the eastern region. Of the 548 ticks collected, 319, 147, 76, and 6 were *Rhipicephalus (Boophilus) decoloratus*, *Rhipicephalus appendiculatus*, *Amblyomma variegatum*, and *Rhipicephalus evertsi evertsi*, respectively. The

Rhipicephalus ticks were more abundant in the central region, whereas *A. variegatum* ticks were more abundant in the eastern region. Tick control malpractices were found in both Central and Eastern Uganda, and 42 of the 56 surveyed farms lacked appropriate restraining facilities and so they utilized either ropes or a ‘boma’ (enclosure). In summary, *B. bigemina*, *T. parva*, *A. marginale* and their co_infections were more prevalent in the central than eastern region; even though, tick control malpractices were observed in both regions. Therefore, an urgent tick and TBD control strategy is needed.

Graphical abstract



Key Words: Acaricide failure, Cattle, Molecular epidemiology, Tick-borne infections, Tick, control malpractices, Uganda.

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