

On-host observations and laboratory behavioral assays were undertaken to investigate the role played by semiochemicals in the location of feeding sites by unfed adults of *Rhipicephalus appendiculatus* Neumann and *Rhipicephalus evertsi* Neumann. The semiochemicals were derived from the host ear and anal region of bovine cattle and from conspecifics. The potential of host-derived allomones from unpreferred feeding sites and extracts of a tick repellent plant, *Ocimum suave* Willd as disrupting factors to on-host orientation by the two tick species to their target sites were also assessed.

Oriental behaviour of *R. appendiculatus* on host was characterized by stereotyped sequences of behaviours, which included stationary/scanning phase, random search, directional movement and arrestment closer to and at the site source. Patterns of tick migratory paths to their respective feeding sites were characterized and quantified in both species. These were made up of runs with intermittent stops, all producing curvilinear tracks. The results of locomotory activities demonstrated a high promotion of completion of paths to the preferred feeding sites, along with high success rates of feeding site location (67.5-90.0% for *R. appendiculatus*; 69.8-85.6% for *R. evertsi*). The results also showed variations in mean walking speed between sexes, species and release points on the host. Mean velocity for males and females averaged 0.09 and 0.41 cm/min in *R. appendiculatus* and 0.24 and 0.58 cm/min in *R. evertsi*.

Assays of tarsi painting on *R. appendiculatus* and *R. evertsi* showed that these were capable of discriminating their respective feeding sites using olfactory cues. In both species, tarsi-coated individuals were less able to orient toward or locate efficiently the relevant anal or ear sites ($P < 0.001$). *In situ* and laboratory assays have implicated primarily site-borne stimuli as mediating factors in this orientation. This kairomone-driven mediation appears to be enhanced by intraspecific signals emitted by feeding ticks present at the feeding site, since ear sites loaded with live ticks ($P < 0.01$) or rinses of fed ticks ($P < 0.01$) were more attractive, although not significantly, compared to control tick-free ears.

Specific behaviours leading to the location and finding of the feeding sites namely: arousal, activation, arrestment and aggregation in response to olfactory stimuli were examined. Arousal tests (in a Y-olfactometer) on *R. evertsi* and *R. appendiculatus* exposed to odour extracts from ear and anus resulted in scanning and residence response patterns that correlated with the stimulatory or inhibitory nature of each extract. Release of ticks *in situ* resulted in the activation of the tick by the host odours after a short latent period which decreased with decrease in distance from the feeding site. Likewise, walking speed of both species resulted in gradual decrease and eventual arrestment in the proximity to the feeding site. Tick velocity correlated with distance and arrestment was more evident at close range (≤ 25 cm away from any site). On the other hand, artificial substrates impregnated with feeding site materials (anal or ear extracts) caused walking arrestment of the relevant species ($P < 0.01$) and evoked in the tick characteristic klinokinetic path patterns on the odourized arena.

Significant aggregation responses of male and female ticks of *R. appendiculatus* occurred on calved scrotum smeared with hexane rinses obtained from fed male and female ticks ($P < 0.05$). The aggregation responses increased slightly with increasing concentrations of the rinses. The aggregation factor remains to be characterized.

Olfactometric assays showed that extracts in washings from various body parts, namely belly/axillae, neck/dewlap and leg were less or unattractive to the adults of *R. appendiculatus*. On the other hand, ear and anal extracts elicited strong attraction to the adults of *R.*

appendiculatus ($P < 0.001$) and

R. evertsi ($P < 0.001$), respectively, in a dose-dependent fashion. Nymphs and larvae of *R. appendiculatus*, in contrast, were significantly repelled ($P < 0.01$). Trapped volatiles from the host were significantly attractive to the ticks than the washes ($P < 0.001$), but the blend of the two was more attractive compared to the individual extracts. The additive effect of the two suggests a dual kairomonal set of components comprising short-range/contact signals and volatile components which mediate feeding selection in this tick.

Cross-assays involving the use of extracts from a site preferred by one tick species showed strong repulsive effect on the other species. Thus, a 'push-pull' mechanism has been proposed to explain highly successful tick orientation and feeding site finding on host and the difference in this regard in these two tick species. The 'pull' component is made of interspecific signals from the preferred sites augmented by intraspecific signals from successfully feeding ticks. The 'push' component comprised of repellents from unpreferred site, which ensures that the tick does not mistakenly orient in that direction.

Repellent extracts from unpreferred feeding host sites and the essential oil of *Ocimum suave* (a tick repellent shrub) were used to study possible disorientation of *R. appendiculatus* and *R. evertsi* toward their respective feeding sites. Cattle repellent extracts and the essential oil of *O. suave* applied as smears to serve as barriers across tick migratory paths to the feeding sites, were disruptive at all concentrations tested. The host extract ($P < 0.05$) as well as the plant extract ($P < 0.001$) significantly reduced the success of *R. appendiculatus* and *R. evertsi* to reach their target site. Ear and anal extracts were found to have short-lived persistent effect on the target ticks, unlike the essential oil of *O. suave*, which was effective for several days during the test period. This may be attributed to differences in concentration rather than intrinsic activity.

These results suggest possibilities of manipulating the host and feeding site location behavior of ticks on- and off-host using appropriate semiochemicals as tactics in the management of tick populations.