

SHORT COMMUNICATION

Vector species composition and malaria infectivity rates in Mkuzi, Muheza District, north-eastern Tanzania

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Abstract: Entomological surveys were conducted in Mkuzi village in Muheza District, north-east Tanzania from April to September 2003. The objectives were to determine the species composition and infectivity rates of mosquitoes in Mkuzi village. Mosquito collection was done using CDC light trap and pyrethrum spray catch (PSC) techniques. The light trap: spray catch ratio was 2.2:1. A total of 2157 mosquitoes were collected (light trap= 1483; PSC= 674). *Anopheles gambiae* s.s. accounted for 56.7% (N=1224) of all mosquitoes collected. Other species were *An. funestus* complex (19.2%) and *Culex quinquefasciatus* (24.1%). The mosquito density per room was 74.15 and 33.7 for light trap and PSC techniques, respectively. A total of 1637 *Anopheles* mosquitoes were tested for circumsporozoite protein by Enzyme linked Immunosorbent Assay (ELISA). The overall infectivity rate for circumsporozoite protein for *P. falciparum* in *Anopheles* mosquitoes was 21.14% (346/1637). Species-specific infectivity rates were 22.7% (278/1224) in *An. gambiae* s.s. and 24.0 % (68/283) in *An. funestus funestus*, 0% (0/80) for *An. rivulorum* and 0% (0/50) for *An. parensis*. Blood meal analysis indicated that 92.3 % of *An. gambiae* s.s., 88.9% of *An. funestus* s.s., 64.5% of *An. rivulorum* and 67.7% of *An. parensis* had taken blood meal from human hosts. In conclusion, malaria transmission in Mkuzi area of Muheza district is mainly by the highly anthropophilic *An. gambiae* s.s. and *An. funestus* s.s. More studies are needed to identify the seasonal variation of species composition and transmission dynamics in this village.

Key words: mosquito, anthropophagy, sporozoite, *Anopheles gambiae*, *An. funestus*, malaria, Tanzania

Malaria is the leading cause of morbidity and mortality in Tanzania. Health facility data indicates that about 19% of all hospital deaths are due to malaria (Kitua, 2003). The lowlands of Muheza district in north-eastern Tanzania has been classified as an area of malaria holoendemic (Mboera & Magesa, 2001). Malaria is the one of the most prevalent severe infectious disease and remains the major cause of the human mortality and morbidity in Mkuzi village, Muheza district (Alilio *et al.*, 2004). In this area of north-east Tanzania malaria is mainly transmitted by *Anopheles gambiae* s.s. and *An. funestus* (Mboera & Magesa, 2001). *An. rivulorum* and *An. marshalli* have also been identified as vectors of malaria in Muheza district (Magesa *et al.*, 1991; Wilkes *et al.*, 1996).

Information of mosquito species composition, abundance and dynamics are important in designing appropriate malaria control strategies. It was the aim of this study to identify the malaria vector species and their infectivity rates in Mkuzi village of Muheza District in northern east Tanzania.

The study was conducted at Mkuzi village about 10 km from Muheza township in north-east Tanza-

nia. Mkuzi village comprises of four sub villages, Mkuzi, Maweni, Kweka and Daisaama. The village has homogenous characteristics in vegetations and house style.

Mosquitoes were collected using CDC light traps and pyrethrum spray catch (PSC) techniques. Five houses were selected for either CDC light trap or spray catch technique in each hamlet. Light traps were hung at the foot-end (30 cm high) of sleeping person under untreated bednets (Mboera *et al.*, 1998). Person sleeping in the room was asked to set the trap and switch on and off at 18:00hr and 06:00hr, respectively. The houses selected were of similar size and type. For PSC technique five houses were also randomly selected in each hamlet. Spraying with 0.4% crude pyrethrum mixed in 99.6% kerosene was done between 06:00hr and 07:30hr. After 10 minutes, mosquitoes knocked down on white sheets were collected and preserved in petridishes with wet cotton and Whatman filter paper.

Mosquitoes collected were identified using morphological key (Gillies & de Meillon, 1968; Gillies & Coetzee, 1987). Female anopheles mosquito were

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kept in dry silica gel and stored at 4°C. Enzyme linked immunosorbent assay (ELISA) was used to detect the circumsporozoite protein for *Plasmodium falciparum* in mosquitoes collected (Wirtz *et al.*, 1987). Identification of the sibling species for *An. gambiae* was performed as described by Scott *et al.* (1993) while that of *An. funestus* complex was done by using Polymerase Chain Reaction (PCR) test (Koekemoer *et al.*, 2002). Blood meal from freshly blood fed mosquitoes caught by spray catch were smeared onto filter paper

All *An. gambiae* s.l were identified to belong to the *An. gambiae* s.s. group. *Anopheles funestus* sibling species was composed of *An. funestus funestus* 68.5% (N=283), *An. rivulorum* 19.4% (N=80) and *An. parensis* 12.1% (N=50) (Table 1). A total of 1637 mosquitoes were tested for circumsporozoite protein, 1224 were *An. gambiae* s.s. and 413 were *An. funestus* s.l. Of the total Anopheles mosquitoes, 346 were found to be positive for *P. falciparum*. *An. gambiae* s.s. accounted for 27.7% (278/1224) while

Table 1: Anopheles species composition collected at Mkuzi area in Muheza District

| Species complex | Species | No | % |
|--------------------------------|------------------------------|------|------|
| <i>Anopheles gambiae</i> s.l. | <i>An. gambiae</i> s.s. | 1224 | 100 |
| <i>Anopheles funestus</i> s.l. | <i>An. funestus funestus</i> | 283 | 68.5 |
| | <i>An. rivulorum</i> | 80 | 19.4 |
| | <i>An. parensis</i> | 50 | 12.1 |

and stored at 4°C for later identification of bloodmeal source by precipitin test (Bray *et al.*, 1984).

A total of 2157 mosquitoes were collected of which 68.8% (N=1483) were collected by light trap and 31.2% (N=674) by pyrethrum spray catch technique. Of the collected mosquitoes, 56.7% (N=1224) were *An. gambiae* s.l.; 19.2% (N=413) were *An. funestus* s.l. and 20.3% (N=520) were *Culex quinquefasciatus*. The light trap: pyrethrum spray catch ratio was 2.2:1. The mosquito density per room was 74.2 and 33.7 for light trap and pyrethrum spray catch, respectively.

An. funestus 24.0% (N=68/283) of the total anopheline mosquitoes. None of the *An. rivulorum* or *An. parensis* was infected with *P. falciparum*. The overall anopheline sporozoite rate was 21.14% (346/1637) (Table 2). The difference in sporozoite rates between *An. gambiae* s.s and *An. funestus* was not statistically significant ($t = 0.316$, $df = 5$, $P = 0.765$). Identification of the blood meal source showed that, 92.3% of *An. gambiae* s.s., 88.9% of *An. funestus*, 64.5% of *An. rivulorum* and 67.7% of *An. parensis* had taken blood meal from human hosts.

Table 2: Sporozoite rates of *An. gambiae* s.s. and *An. funestus* in Mkuzi area, Muheza District

| Species | No. examined for sporozoite | No. infected | % infected |
|------------------------|-----------------------------|--------------|------------|
| <i>An. gambiae</i> s.s | 1224 | 278 | 22.7% |
| <i>An. funestus</i> | 283 | 68 | 24.0% |
| <i>An. rivulorum</i> | 80 | 0 | 0 |
| <i>An. parensis</i> | 50 | 0 | 0 |
| Total | 1637 | 346 | 21.14% |

Discussion

An. gambiae s.s and *An. funestus* sibling species were the major malaria vectors in Mkuzi village in Muheza district of north-eastern Tanzania. *An. gambiae* s.s existed in higher proportion than *An. funestus* sibling species. In the coastal part of Tanzania *An. gambiae*, s.s and *An. funestus* s.l have been identified to be major vectors of malaria (Mnzava & Kilama, 1986; Temu *et al.*, 1998). The infectivity rates of the two species are among the highest recorded in the areas (Mboera & Magesa, 2001). In the current study, light trap caught more Anopheles mosquitoes than the spray catch techniques. This indicate that majority of the mosquitoes collected were host-seeking than resting.

Like in our study, Gillies (1964a) did not find sporozoite infected *An. rivulorum* in a sample of 147 mosquitoes. However, Wilkes *et al.* (1996) found 0.5% (5/1022) of the *An. rivulorum* were infected with malaria sporozoites in a study in villages around Muheza town. Our results showed that *An. gambiae* s.s and *An. funestus* are highly anthropophilic. Blood meal analysis indicated that *An. gambiae* s.s and *An. funestus* s.s. In addition over two-thirds of *An. rivulorum* and *An. parensis* had taken blood meals from human hosts. This high degree of human blood preference is likely to contribute to high malaria prevalence among residents in this area of north-eastern Tanzania (see Mboera, 2000). No multiple blood feeding was found in this area irrespective of the availability of cattle and other domestic animals. Similarly, Gillies (1964b) found mixed feed to account for less than 0.5% of the blood meals tested In his study on host-preference in *An. gambiae* in Muheza. Our study was however, limited by the fact that it only collected indoor biting/resting mosquitoes and only covered part of the year. A longitudinal study is likely to provide more information on the distribution and variation of the parameters studied throughout the year.

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