



ISSN 2320-7078
JEZS 2014; 2 (5): 46-48
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Received: 04-08-2014
Accepted: 28-08-2014

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Observations on nocturnal endophagy in *Aedes (Stegomyia) albopictus* (Skuse), 1894 from Kerala, India

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Abstract

Aedes (Stegomyia) albopictus has been widely reported to be a predominantly diurnal and outdoor feeder from different parts of the world. Studies conducted in Kerala during May 2012- December 2013 showed this species exhibiting nocturnal endophagy during May to August. Highest per night density was obtained in July (2.2 and 1.5 in 2012 and 2013 respectively), followed by June (1.9 and 1.3 in 2012 and 2013 respectively). Indoor biting during day and night did not show significant difference. Maximum biting activity was observed between 22:30-23:00 hours (75 mosquitoes). This was followed by the period between 20:30-21:00 hours (65 mosquitoes). Further studies should be conducted to establish the significance of this behaviour in relation to disease transmission.

Keywords: *Aedes (Stegomyia) albopictus*, endophagy, dengue, Chikungunya

1. Introduction

The role of *Aedes albopictus* as a vector of Dengue and Chikungunya in Kerala has gained tremendous significance in recent years. The year 2003 witnessed the spread of dengue throughout the state with 3546 confirmed cases and 68 deaths [1]. *Ae. albopictus* was suspected to be the major vector during the outbreak. In 2004 dengue virus was detected in *Aedes albopictus* from specimens collected near Calicut Airport in Kerala, thus confirming the suspicion to be genuine [2]. The state had the first outbreak of Chikungunya during June-July 2006 along the coastal areas of Alleppey, Quilon and Trivandrum districts and again during May-August 2007 in Pathanamthitta, Kottayam and Idukki districts [3, 4]. In 2008, A226V mutation in the glycoprotein envelope 1 (E1) gene of the virus among isolates collected from the three worst-affected districts of the state during this outbreak was reported [5]. This mutation had already been suggested to be directly responsible for a significant increase in CHIKV infectivity in *Ae. albopictus*. Besides, way back in 1964 Rao *et al* demonstrated the ability of the species for transmitting an Indian strain of Chikungunya virus in the laboratory [6]. Since 2006, the disease has been widening the area of its influence in the state. Kerala has tremendous potential for the breeding of this species. Latex-collecting containers in the rubber plantations of the state were found to be ideal breeding sites for this species during rainy season [7].

Studies on the biology of *Ae. albopictus* have been reviewed by Hawley [8]. Most of the studies till 1988 reported it to be a diurnal and exophagic species, exhibiting bimodal feeding activity. However, diurnal endophagy and nocturnal exophagy were also reported rarely from different countries. Biting activity of *Ae. albopictus* in Brazil has been reported during the day with peaks at 6:00 a.m., 1:00-2:00 pm and the highest between 4:00 and 5:00 pm [9]. In a study conducted in Reunion island, *Ae. albopictus* was found to have exophagic (89%) and exophilic (87%) behaviours [10]. However, in May 2012, the present author observed indoor biting activity of the species at night. Subsequently, a study was conducted from May 2012 to December 2013 to confirm this random observation.

2. Material and Method

The study was conducted in Vadakara municipality of Kozhikode district in Kerala, India. Vadakara lies at latitude 11.60° N and longitude 75.58° E. It has a population of 75295 (2011 Census). Mosquito collection was done in 6 houses. Landing and probing mosquitoes were

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collected by aspirators and test tubes. Collection was done between 19:00 hrs and 23:30 hours. Mosquitoes collected at 30 minutes intervals were kept as separate batches. Identification was done using the keys to species by Barraud [11] and Huang [12]. Analysis of the data was done on monthly basis. Per night density was calculated by dividing total number of mosquitoes collected in a month by number of days in the month. To compare the diurnal and nocturnal feeding activity (indoor), biting and landing mosquitoes were collected from 6:00 hours to 18:00 hours at weekly intervals in the month of July, 2012 and July, 2013. Mosquitoes collected at two hours intervals were kept as separate batches. Per day density was calculated by dividing total number of mosquitoes collected by number of weeks. Statistical analyses of the data were done by SPSS. The study was approved by the Institutional Ethics committee

of the college and written informed consents were obtained from the volunteers who participated in the study.

3. Results

As can be seen from table-1, biting activity was observed from May-August only. Both in 2012 and 2013 highest activity was observed in the month of July (2.2 and 1.5 respectively), followed by June (1.9 and 1.3 respectively). Compared to 2012, number of mosquitoes collected in 2013 was less (0.68-2.2 and 0.55-1.5 respectively) but the difference was not statistically significant ($p= 0.1818$). Maximum biting activity was observed between 22:30-23:00 hours (75 mosquitoes). This was followed by the period between 20:30-21:00 hours (65 mosquitoes). Biting was not observed between 20:00-20:30 hours.

Table: 1 Biting and landing *Aedes albopictus* females collected at night from May 2012 - December 2013

	19:00-19:30	19:30-20:00	20:00-20:30	20:30-21:00	21:00-21:30	21:30-22:00	22:00-22:30	22:30-23:00	23:00-23:30	Total (per night density)
May 2012	4	1	0	6	3	2	3	7	3	29 (0.93)
June	9	2	0	11	7	3	2	13	10	57 (1.9)
July	11	3	0	13	9	2	3	16	11	68 (2.2)
August	2	0	0	5	2	1	2	6	3	21 (0.68)
September	0	0	0	0	0	0	0	0	0	0
October	0	0	0	0	0	0	0	0	0	0
November	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0
January 2013	0	0	0	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0	0	0	0
March	0	0	0	0	0	0	0	0	0	0
April	0	0	0	0	0	0	0	0	0	0
May	4	1	0	6	2	1	0	5	2	21 (0.67)
June	8	2	0	9	6	1	1	9	3	39 (1.3)
July	9	2	0	11	3	2	2	13	6	48 (1.5)
August	3	1	0	4	1	0	0	6	2	17 (0.55)
September	0	0	0	0	0	0	0	0	0	0
October	0	0	0	0	0	0	0	0	0	0
November	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0
Total	50	12	0	65	33	12	13	75	40	300

Day time collection (Table-2) yielded 2.8 mosquitoes per day in July 2012 and 1.8 in 2013. Peaks of biting activity were between 6:00 and 10:00 hours in the morning and between

16:00 and 18:00 hours in the evening. The difference between nocturnal and diurnal biting activity was not significantly different ($p= 0.26885$).

Table 2: Biting and landing *Aedes albopictus* females collected during daytime in July 2012 and 2013

Month/ year	No. of <i>Aedes albopictus</i> collected						Total (per day density)
	06:00-08:00	08:00-10:00	10:00-12:00	12:00-14:00	14:00-16:00	16:00-18:00	
July 2012	4	3	1	0	0	3	11 (2.8)
July 2013	3	2	0	0	0	2	7 (1.8)

4. Discussion

The study has revealed that nocturnal endophagy is not a random phenomenon in *Ae. albopictus*. Nocturnal endophagy was observed in the pre-monsoon (May) and South-West monsoon period. Kerala receives pre-monsoon showers in the month of May leading to population build-up of the species. The difference in per night densities in 2012 and 2013 could

be due to ongoing anti-mosquito activities undertaken by the department of health services through source reduction and awareness programmes. Since day time biting was not significantly higher than nocturnal activity, the observation of low density in the night collections could have been due to low level of breeding. However, more studies are required to substantiate this hypothesis. Simultaneous studies on the

breeding indices and indoor and outdoor biting behaviour during day and night are required to substantiate the significance of nocturnal endophagy in *Ae. albopictus* in relation to disease transmission in the state and elsewhere.

5. Acknowledgements

The author wishes to record his sincere gratitude to the volunteers, who have requested to be anonymous, for assisting in the study. He also remembers his son Master Ujwal Sumodan, who collected the first mosquito indoors in April 2012, which led to this research.

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