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The biting patterns of *Culex* mosquitoes in the Udaipur district of southern Rajasthan

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Abstract

The objective of this study was to determine the abundance and biting patterns of *Culex* mosquitoes in the Udaipur region of Rajasthan. Collection was carried out by light torch and oral aspirator (suction tube) from April, 2021 to March, 2022). A total of 227 *Culex* female mosquitoes were collected. Out of total collection, 109 mosquitoes were collected from cattle sheds (51 mosquitoes from indoor and 50 mosquitoes from outdoor) and 118 mosquitoes were collected from human dwellings (63 mosquitoes from indoor and 55 mosquitoes from outdoor). The highest numbers of females was caught between 0300 to 0400 hours and 2000 to 2200 hours. The density of biting populations in human dwellings was higher than in cattle sheds, indicating the available of blood meals in the biting behaviour of *Culex* mosquitoes.

Keywords: *Culex* mosquito, biting behaviour, human dwelling, cattle sheds, density

Introduction

Mosquitoes are found all over the world except Antarctica. They belong to the order Diptera of the class insecta. Members of the *Anopheles*, *Culex* and *Aedes* genera primarily bite humans. Mosquito impact human welfare both directly as a nuisance and through transmission of pathogens that cause malaria, filariasis, chikungunya, Japanese encephalitis and dengue fever in humans and a variety of diseases in other animals. They spread diseases to more than seventy crore people each year and will be responsible for the death of 1 out of every 17 people currently alive. Therefore to control mosquitoes, many states and agencies have established mosquito control programs [2-6].

Culex quinquefasciatus is a cosmopolitan mosquito that, spreads throughout the world, especially in tropical and subtropical regions, and is associated with human habitations. Adult females lay eggs in relatively large, permanent aquatic habitats where there are high concentrations of dissolved organic matter, such as sewage waste and septic tanks. However immature stages of this species can be found in artificial containers that are often filled with polluted water, but rarely co-exist in the same containers with the *Aedes aegypti* [7].

The relationship of relative humidity and average temperature with mosquito abundance was generally weak. Since mosquito abundance was higher in all communities during the rainy season compared to the dry season, it would be more appropriate to control mosquitoes in communities during the rainy season [8].

Precipitation and temperature provide essential mosquito life history traits such as transmission intensity including mosquito growth rates, biting rates and survival rates [9]. precipitation and temperature are proxy variable that represent density levels of mosquitoes [10]. Adult mosquitoes rest in their display locations most of the time rather than in flight, with most species resting entirely outdoors in natural resting sites and only a few species in artificial shelters. Only a few indoor-resting mosquito species are known to be carriers of malaria, filariasis and arboviruses [11].

Several method are used to control mosquito-borne disease, including the use of repellents. Repellents play an effective role in reducing human vector contact and also help in reducing disease transmission. There are many synthetic and plant-derived repellents available for mosquito control.

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A large number of plant-based components show physiological and behavioral activities towards mosquitoes. On the other hand chemicals are always very successful in mosquito control operations. It is necessary to find effective repellents that can reduce mosquitoes by destroying them or preventing them from biting humans [12-16].

Materials and Methods

The study area was the Udaipur district of Rajasthan province. Udaipur is located at 24°58'N; 73°68'E. Its average elevation is 598 meters (1961 feet) and total area is 64 km². The climate of the study area is hot semi-arid. The climate and weather of the study area is generally hot with three seasons' summer, monsoon and winter respectively. The summer season lasts from mid-March to June with temperature reaching 23°C (73°F) to 44° (111°F) in the months of March to June. Monsoon arrives in the month of July with dust and storms. Winter season lasts from October to March. The humidity present during monsoon reduces with the arrival of winter. Temperature between 5°C (41°F) to 30°C (86°F). Biting mosquitoes were collected during the period April, 2021 to March, 2022 to assess feeding behaviour in different localities. A mechanical aspirator was used to collect adult mosquitoes using a flash light during 1800 to 0600 hours. The collected samples were brought to the laboratory and identified with standard [1] keys. Data were collected 30 nights and average values were calculated.

Result and Discussion

The present study is designed to study the biting behaviour of the *Culex* mosquitoes, in Udaipur, Rajasthan, India from April, 2021 to March, 2022. This period was chosen because mosquitoes proliferate during this rainy season. The impacts of bites was greater during rainy season.

In the human dwelling biting *Culex* mosquitoes were collected for feeding behaviour throughout the night on human bites and cattle bites during April, 2021 to March, 2022. (Table-1)

A total of 227 specimens belonging to four species of *Culex* mosquitoes were collected over a week's nightly collection. Out of total collection, 109 specimens were collected from cattle bites (51 specimens from indoor and 58 specimens from outdoor) and 118 specimens were collected from human bites collection. The maximum number of specimens collected was both *Culex quinquefasciatus* and *Culex pseudovishnui* with 91

specimens or 40.08%, followed by *Culex gelidus* (28 specimens or 12.33%) and *Culex vagans* (17 specimen or 7.48%)

During the collection of human biting the highest number of *Culex* mosquitoes were recorded 8 from 0300 to 0400 hours and 7 *Culex* mosquitoes each from 2000 to 2100 and 2100 to 2200 hours. 05 *Culex* mosquitoes were caught from 0100 to 0200 hours. While no *Culex* mosquitoes were caught from 0500 to 0600 hours.

The highest number of *Culex pseudovishnui* mosquito was 11 recorded from 2000 to 2200, followed by 7 from 0300 to 0400 hours and no *Culex pseudovishnui* mosquitoes were recorded from 1800 to 2000 hours. *Culex gelidus* and *Culex vagans* were recorded in very low number from 0100 to 0200 hours and 0300 to 0400 hours, while *Culex gelidus* and *Culex vagans* were not found during morning and evening hours.

In the cattle biting a total of 58 *Culex* mosquitoes were recorded in outdoor, out of which the maximum of 32 *Culex pseudovishnui* were recorded followed by 14 *Culex quinquefasciatus* and 10 *Culex gelidus* and 2 *vagans* were recorded (Table 2).

In outdoor *Culex pseudovishnui* was recorded from 2000 hrs to 2200 hrs and from 2300 to 0500 hours, whereas in evening and morning it was not recorded. *Culex quinquefasciatus* was recorded from 0100 to 0500 hours, whereas from 2200 to 0100 hours was not recorded. Similarly *Culex gelidus* and *Culex vagans* were not recorded from 2200 to 0300 hours. Whereas *Culex gelidus* was recorded from 1800 to 2200 hours.

The density of female mosquitoes was highest at the end of the rainy season and at the beginning of the dry season in urban areas of upper volta [17], rural areas [18] and at the beginning of the rainy season in kaduna, northern Nigeria [19]. In West Africa the average density during the rainy season is often ten times higher than the density during the dry season [17]. The findings of this study revealed that different locations of human dwelling caused different responses, which influenced of *Culex quinquefasciatus* attempting to feed the blood of their host. Mosquito density was higher on the ground floor than on the upper floors and was at its peak during mid-night [20].

Temperature is always inversely correlated with mosquito population density, while precipitation is always positively correlated with the abundance of *Culex quinquefasciatus* this matches Lindsay's findings [21].

Table 1: Human biting collection of *Culex* mosquitoes from indoor and outdoor during (night) 1800-0600 hours, in different localities of Udaipur (April, 2021-March, 2022)

Mosquitoes Collected		1800 1900 hours	1900 2000 hours	2000 2100 hours	2100 2200 hours	2200 2300 hours	2300 2400 hours	2400 0100 hours	0100 0200 hours	0200 0300 hours	0300 0400 hours	0400 0500 hours	0500 0600 hours	Total
Indoor	<i>Culex quinquefasciatus</i>	1	0	7	7	0	1	0	5	0	8	1	0	30
	<i>Culex pseudovishnui</i>	0	0	5	6	1	0	0	3	0	7	1	1	24
	<i>Culex gelidus</i>	0	0	1	1	0	0	0	1	0	2	0	0	5
	<i>Culex vagans</i>	0	0	1	0	0	0	0	2	0	1	0	0	4
	Total	1	0	14	14	1	1	0	11	0	18	2	1	63
Outdoor	<i>Culex quinquefasciatus</i>	1	0	5	6	0	0	0	4	1	3	5	0	25
	<i>Culex pseudovishnui</i>	0	0	4	4	0	0	0	3	0	4	3	1	19
	<i>Culex gelidus</i>	0	0	1	2	0	0	0	1	0	0	0	0	4
	<i>Culex vagans</i>	0	0	1	1	0	0	0	2	0	1	2	0	7
	Total	1	0	11	13	0	0	0	10	1	8	10	1	55
Grand total		2	0	25	27	1	1	0	21	1	26	12	2	118

Table 2: Cattle biting collection of *Culex* mosquitoes from indoor and outdoor during (night) 1800-0600 hours, in different localities of Udaipur (April, 2021-March, 2022)

Mosquitoes Collected		1800 1900 hours	1900 2000 hours	2000 2100 hours	2100 2200 hours	2200 2300 hours	2300 2400 hours	2400 0100 hours	0100 0200 hours	0200 0300 hours	0300 0400 hours	0400 0500 hours	0500 0600 hours	Total
Indoor	<i>Culex quinquefasciatus</i>	0	1	3	4	0	2	0	3	1	5	2	1	22
	<i>Culex pseudovishnui</i>	1	0	2	3	1	1	0	2	2	4	0	0	16
	<i>Culex gelidus</i>	1	2	0	1	0	2	1	1	0	1	0	0	9
	<i>Culex vagans</i>	0	0	0	2	0	1	0	0	0	1	0	0	4
	Total	2	3	5	10	1	6	1	6	3	11	2	1	51
Outdoor	<i>Culex quinquefasciatus</i>	0	0	1	3	0	0	0	3	2	4	1	0	14
	<i>Culex pseudovishnui</i>	0	0	5	6	0	3	3	7	1	6	1	0	32
	<i>Culex gelidus</i>	2	1	3	2	0	0	0	0	0	2	0	0	10
	<i>Culex vagans</i>	0	0	0	1	0	0	0	0	0	1	0	0	2
	Total	2	1	9	12	0	3	3	10	3	13	2	0	58
Grand total		4	4	14	22	1	9	4	16	6	24	4	1	109

Conclusion

The vector population was higher in human dwellings than in cattle sheds. Although it feeds throughout the night the peaks of biting activity was reported three times, once at 2000-2200 hours, second time in the middle of the night and last just before the morning (0300 to 0400 hours).

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