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## Host Selection and Multiple blood feeding behavior of *Culex quinquefasciatus* in Raipur city, Chhattisgarh state, India

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### Abstract

**Background:** Identification of host preferences of mosquitoes is crucial for elimination of vector born diseases like filariasis. However, little information is available on the host preferences of culicine mosquitoes in Chhattisgarh state. Therefore, the objective of the present study was to determine the hematophagic tendencies of the *Culex quinquefasciatus* inhabiting a filaria-endemic area of Raipur city, Chhattisgarh state, India.

**Methods:** Adult culicine mosquitoes were collected using light traps (LTs) and human bait (HB) from a filaria-endemic areas during the peak months of mosquito's population (August-September). Agar gel diffusion method for the identification of mosquito's blood meal was used. The blood meal of each mosquito was tested against antisera specific to human, cow, buffalo, goat, fowl, dog, rat, rabbit, guinea pig, cat and pig.

**Results:** Out of 140 specimens collected from human dwellings 122 were positive for human blood with an Anthropophilic Index of 89.70%. Of the 123 specimens collected from cattle sheds, 76 were positive for human blood, 41 for bovine while 6 specimens were positive for both human and bovine blood. Out of the 90 specimens from mixed dwellings 60 reacted against antihuman, 24 against bovine, 1 against dog antisera. 5 specimens reacted mixed with both human and bovine antisera.

**Conclusions:** The observed high anthropophilic nature of *Culex quinquefasciatus* revealed these species to be important filarial vectors in slum areas of Raipur city.

**Keywords:** Culex, filariasis, host preference, Anthropophilic index

### 1. Introduction

Knowledge of host preferences or feeding habits exhibited by vectors is an important step in the epidemiological study of vector born diseases. The host preference patterns of vector mosquitoes influence greatly the dynamics of the transmission of infection in the community. The identification of blood constituents of mosquito stomach indicates host preference exhibited by the prevalent mosquito species. Female mosquitoes are known to feed on the blood of a wide variety of animals including men, monkeys, horses, dogs, pigs, camels, other ruminants and birds etc. Some exhibit distinct preferences in this regard while others are facultative and feed on any animal that is available for a bite (Rao, 1984) [19]. Bruce Chawatt *et al* (1966) [7] made a distinction between host selection and host preference. Host selection indicates the host actually fed upon and host preference indicates the innate habit of exercising choice of a host (s). The proportion of bites on humans by a population of mosquitoes defines the population's Anthropophilic Index (AI). The Human Blood Index (HBI) was defined by WHO (1963) [28] as "the proportion of freshly fed mosquitoes giving a positive reaction for human blood". These indices are required in assessing their vectorial capacity (Garrett-Jones *et al*, 1980) [12] and also to understand indirectly the extent of man-vector contact in an area and thus the transmission behavior of a disease. However, the innate behavior of a species to bite a human being or other animals may vary according to the environmental conditions prevailing in the area. Human blood indices and feeding preference of Indian mosquitoes, especially anophelines, have been widely studied (Tewari *et al*, 1984; Collins *et al*, 1991; Roop kumari *et al*, 1993) [26, 8, 20].

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The host preference studies on *Cx. quinquefasciatus* in other parts of the country showed that man as the preferred host with the Anthropophilic Index varying from 63% to 83% (Satya Prakesh *et al*, 1962) [21]. Bosh and Sinha (1964) [6] reported man as a preferable host for *Cx. quinquefasciatus* and the type of shelter does not have any bearing on the preference to feed on host available in the shelter. Subra (1970) [22] reported that the Anthropophilic Index was higher in mosquitoes captured indoor than those captured outdoor. Dhar *et al* (1968) [10] recorded Anthropophilic Index of 88% in *Cx. quinquefasciatus* from Rajahmundry, Andhra Pradesh. Kaul and Wattal (1968b) [14] observed that the Anthropophilic Index of *Cx. quinquefasciatus* was 14.2% in winter and 81.1% in summer in a village near Delhi, India, and these variations were attributed to the human living behavior in two different seasons. The HBI of *Cx. quinquefasciatus* was found to be 88.07%, 93.7% and 90.4% in summer, rainy and winter seasons respectively in Puri district of Orissa (Mahapatra *et al*, 1995) [15]. Gnanakumar *et al* (1997) [11] analyse four species in two rural areas near Madurai and reported that *Cx. quinquefasciatus* had high Anthropophilic Index (51.8%). In this study an attempt has been made to work out the Anthropophilic Index of *Cx. quinquefasciatus* at Raipur, the principle vector of lymphatic filariasis in the region.

## 2. Materials and methods

Freshly engorged female *Cx. quinquefasciatus* were collected from human dwellings, cattle sheds and mixed dwellings of Raipur city using oral aspirator in morning hours (06:00-08:00). The average distance between cattle sheds and human dwellings ranged from 15-20 meters. Mosquitoes were brought to the laboratory and identified following Barraud (1934) [2]. The blood meals from engorged

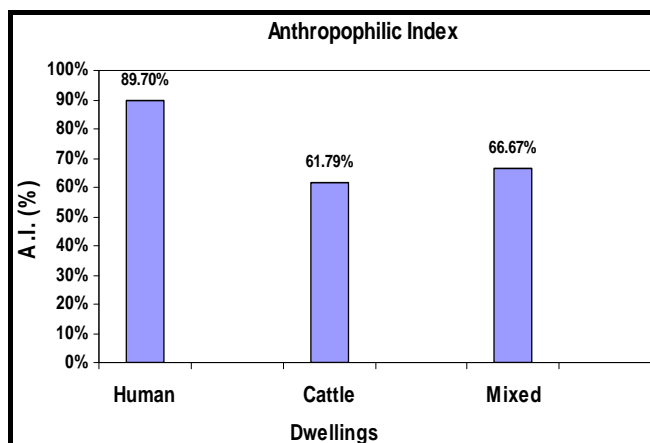
mosquitoes were collected on Whatman-1 filter paper and were diluted in to 0.5 ml of .01 M Phosphate buffer saline (pH 7.2) at 4 °C for 8 hours. Agar gel diffusion method for the identification of mosquito's blood meal was used following Collins *et al* (1991) [8]. The blood meal of each mosquito was tested against antisera specific to human, cow, buffalo, goat, fowl, dog, rat, rabbit, guinea pig, cat and pig. All the antisera were obtained from Serologist and Chemical Examiner to Government of India, Department of Serology, Kolkata. Slides were incubated after loading the samples in humid chamber at 4 °C over night and were examined for precipitin bands after staining with 1% Amidoblack.

## 3. Results

The results of present study are presented in Table 1.1.1. A total of 360 blood meal samples of *Cx. quinquefasciatus* collected from three habitats were subjected to double immuno diffusion. 349 samples showed positive reaction while 11 did not show precipitin line with any of the antisera tested and hence were considered negative for the blood meal tested. Of the 140 specimens collected from human dwellings 122 were positive for human blood with an Anthropophilic Index of 89.70% (fig. 1.1.1). Of the remaining 14 specimens, 5 were positive with bovine antisera, 2 with dog antisera, 1 with goat and 2 with fowl antisera. 4 samples reacted mixed with human and bovine antisera. 4 specimens failed to show reactivity with any of the antisera employed. Of the 123 specimens collected from cattle sheds, 76 were positive for human blood, 41 for bovine while 6 specimens were positive for both human and bovine blood. Of the 90 specimens from mixed dwellings 60 reacted against antihuman, 24 against bovine, 1 against dog antisera. 5 specimens reacted mixed with both human and bovine antisera.

**Table 1.1.1:** Host feeding pattern of *Cx. quinquefasciatus* at Raipur

Shelter Type	Number		No. of samples Positive for							A.I.
	Tested	Positive	Man	Bovine	Dog	Goat	Fowl	Rabbit	Mixed*	
Human	140	136	122	5	2	1	2	0	4	89.70%
Cattle	123	123	76	41	0	0	0	0	6	61.79%
Mixed	90	90	60	24	1	0	0	0	5	66.67%
Total	360	349	258	70	4	0	2	0	15	72.72%



**Fig 1.1.1:** Anthropophilic Index of *Cx. quinquefasciatus* from different dwellings

## 4. Conclusions

The determination of mosquito's blood meal helps to understand pathogen life cycles, their potential hosts and to identify control strategies (Boreham 1975, Tempelies 1975, Ngumbi *et al* 1992) [5, 23, 16]. Host feeding or host selection pattern is a product of numerous factors including host preference, host availability and host irritability. Based on blood meal identification studies, two host selection strategies have been evolved *viz.* (a) fixed or active and (b) passive or opportunistic (Washino and Tempelies, 1983) [27]. Some mosquitoes such as *Culiseta inornata* and species of *Aedes* and *Anopheles*, appear to have 'fixed' host preference pattern and feed primarily on mammals, others such as *Culiseta melanura* and several species of *Culex* feed primarily on birds; a third group, which includes *Cx. tarsalis* and members of *Cx. pipiens quinquefasciatus* complex, exhibit a variable feeding pattern with regard to mammals and birds. Epidemiologically, it is quite important to know

the relative extent to which the feeding pattern of this latter group are influenced by availability or host preference furthermore, it is desirable to know the condition of host availability under which species with fixed feeding pattern may deviate from their normal hosts. *Cx. Pipiens* in Colorado (Tempelis *et al*, 1967) <sup>[25]</sup> and *Cx. quinquefasciatus* in California (Tempelis and Reeves, 1964) <sup>[24]</sup> were found to feed almost entirely on birds and no seasonal change in host range was observed. *Cx. Quinquefasciatus*, the only vector of bancroftian filariasis at Raipur exhibited high Anthropophilic Index from all dwellings indicating the feeding preferences of the vector. 61.79% of the mosquitoes from cattle shed showed blood meal positive for human. Similarly 66.67% of the mosquitoes from mixed dwelling were positive for human blood. The fact that 11 specimens did not show reactivity with any of the antisera employed indicate three possibilities: (i) The volume of these blood meals collected on Whatman-1 paper were not adequate enough to show reactivity in double Immunodiffusion (ii) The source of blood meal is from other than those tested & (iii) Due to partial digestion of serum protein. The digestion could have destroyed some of antigenic sites of serum which were originally present in the antigen used for immunization.

Bhattacharyya *et al* (1994) <sup>[4]</sup> while observing host feeding pattern of *Cx. vishnui* sub group of mosquitoes (*Cx. triataeniorhynchus*, *Cx. vishnui* and *Cx. pseudovishnui*) in Dibrugarh district of Assam noticed that all three species were essentially zoophilic showing preference to bovine and pig blood. Human contacts of these species were occasional (0.5%). Similar observation were recorded in population from Tamilnadu (CRME, 1989) <sup>[9]</sup>. The vector has been found to be highly anthropophilic in other parts in India (Dhar *et al*, 1968; Gowda and Vijayan, 1992; Mahapatra *et al*, 1995; Ganakumar *et al*, 1997) <sup>[10, 13, 15, 11]</sup> as well as outside India (Beier *et al*, 1990) <sup>[3]</sup>. Arunachalam (1987) <sup>[1]</sup> recorded very high (98.7%) Anthropophilic Index in *Cx. quinquefasciatus* females collected from human dwellings at Pondicherry. The availability and microclimatic conditions appear to play a significant role on the feeding pattern of vector. The season appeared to have no marked effect on the Anthropophilic Index (Rao *et al*, 1980, 1981) <sup>[17, 18]</sup> of *Cx. quinquefasciatus*.

The analysis of mosquito blood meal from cattle sheds and mixed dwellings reveal that *Cx. quinquefasciatus* in Raipur city prefer human host given the choice. The results also suggests that the vector can feed on available host if human host is absent in the vicinity. Thus the present study indicates that *Cx. quinquefasciatus* in Raipur city is preferentially anthropophilic in nature.

The agarose gel diffusion method has the advantage of eliminating the floating debris, cloudiness and turbidity of reactants as these factors get filtered during diffusion through gel. These slides could be preserved, after staining, for reference. The agarose diffusion method gives rapid results in determining the host preferences of mosquitoes in a given locality.

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