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Origin of blood meal sources in *Culex quinquefasciatus* in northern Benin

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Abstract

To explore the origin of blood meal sources in *Culex quinquefasciatus* at Djougou, north-West of Benin, a study was carried out in four households (two in urban and two in rural areas) from August to October 2021. Four households were selected for adult's mosquito's collection. Therefore, Pyrethrum spray collection (PSC) method was used in the selected households from 07:00 am to 9:00 am twice a week where knocked down mosquitoes were collected and kept in Eppendorf tubes for further identification. All the mosquitoes collected were identified and classified as *Culicinae* or *Anophelinae* based on the identification keys. The origin of the blood meal in females of *Cx. quinquefasciatus* was determined by ELISA (Enzyme Linked Immunosorbent Assay). A total of 13,598 mosquitoes belonging to seven different species from the collection sites was recorded. The majority (82.5%) was *Cx. quinquefasciatus* regardless of the areas of collection. Moreover, the majority of the of *Cx. quinquefasciatus* collected tested for blood meal revealed that 88.5% fed on human. The remaining fed on goat (6, 5%), beef (3%) and pork (2%). These data on the origin of blood meal sources in *Cx. quinquefasciatus* at Djougou Benin will serve as a new tool to control *Cx. quinquefasciatus*.

Keywords: *Culex quinquefasciatus*, blood meal, Elisa, Djougou, Benin.

Introduction

Culex quinquefasciatus (Diptera: Culicidae) is broadly mosquito distributed in tropical and subtropical areas and it's the most important vector of Lymphatic filariasis (LF) parasite *Wuchereria bancrofti* which affected more than 120 million people in 80 countries [1-4]. It transmitted several arboviruses like West Nile virus (WNV), Rift Valley fever virus, avian pox and protozoa like *Plasmodium relictum* that causes bird malaria [5, 6].

To reduce the (LF) transmission caused by the filarial parasite *Wuchereria bancrofti* and transmitted by *Cx. quinquefasciatus* Say, a mosquito which breeds in polluted water habitats such as pit latrines [7-9], many programs based on mass drug administration (MDA) showed a good results in the elimination phase. In addition, there has been a growing recognition on the potential role of vector control as a supplementary component to MDA [10-12]. Moreover, many reports highlighted the use of insecticide treated bed nets (ITNs) and the implementation of Indoor Residual Spraying (IRS) as tools in reduction in prevalence and transmission of LF [13-15]. However, despite these strategies to reduce the incidence of LF, *Cx. quinquefasciatus* is still able to feed on its hosts and to collect parasite-infected blood during it blood meal [16, 17]. Therefore, the identification of the source of blood meals of *Cx. quinquefasciatus* seems to be a tool for mosquito's control.

In northern Benin, no previous studies have evaluated the feeding behavior of *Cx. quinquefasciatus* despite the presence of this mosquito year-round in this district with several cases of lymphatic filariasis [8]. It is therefore crucial to study the origin of blood meal sources in *Culex quinquefasciatus* at Djougou, North West of Benin for a better control of this mosquito.

2. Materials and Methods

2.1. Study area

The study was conducted in the district of Djougou (North-west of Benin, 1°23 E, 10°18 N), which is characterized by a sub-equatorial type climate with one rainy season and one dry

season. The temperature in the area ranges from 22 to 40°C.

2.2. Mosquito collections

Adults of *Cx. quinquefasciatus* were collected during the rainy season in two urban areas (Founga and Zountori) and two rural areas (Nima and Bougou 2) (Figure 1) from 4 households. In each study site, 4 households were selected for

adults' collection. Indoor Pyrethrum Spray Catches (PSC) was carried out in the selected households from 07:00 am to 9:00am and twice a week from August to October 2021. Fifteen minutes after spraying the rooms, all mosquitoes knocked down were collected and stored in Eppendorf tubes labelled with the name of place of collection, date of collection, and room number for further identification.

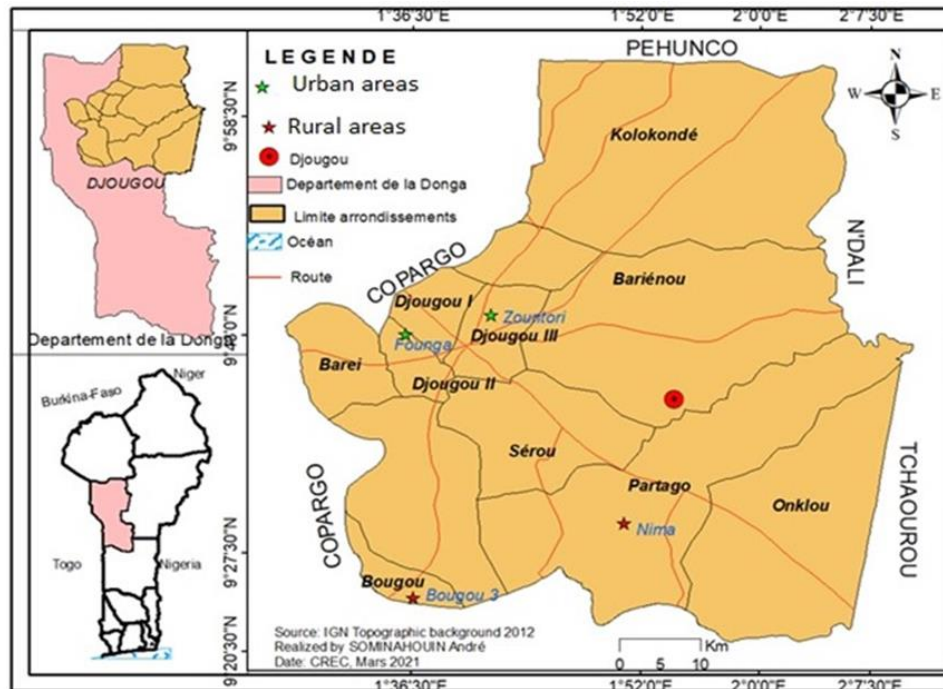


Fig 1: Map of Djougou showing the sites of the collections

2.3. Morphological identification of captured mosquitoes

Base on the identification keys [18-21], all mosquitoes collected in the different sites were identified and classified as *Culicinae* or *Anophelinae*.

2.4. Laboratory processing of mosquitoes

800 blood-fed *Cx. quinquefasciatus* from each study site, were tested in order to know the origin of blood-fed indoor resting mosquitoes of *Cx. quinquefasciatus*, following the Sandwich ELISA protocol [22]. Blood meals were tested for the presence of goat, human, pig, and beef immunoglobulin G (IgG).

3. Results

3.1. Mosquito fauna

Overall, 13,598 mosquitoes were collected by pyrethrum spray captures (PSC) at the four study sites (Table 1). The majority was *Culex* spp regardless of the areas of collection. However, the populations of *Cx. quinquefasciatus* (9,113) collected in the two urban areas were approximately 2 times higher ($P < 0.05$) than those collected in rural areas (4,685). The same trend was observed with other populations of mosquitoes where those collected in urban areas are more important than those collected in rural areas.

Table 1: Mosquito fauna recorded in the different collection sites.

	Urban areas		Rural areas	
	Founga	Zountori	Nima	Bougou 2
Total mosquitos caught	4,616	4,497	2,313	2,372
Total <i>Culex</i> spp	3,580	3,510	1,834	1,880
Total <i>Anopheles</i> spp	954	914	435	454
<i>An. gambiae</i> s.l	818	798	393	415
<i>An. pharoensis</i>	88	79	32	27
<i>An. ziemanni</i>	42	33	9	12
<i>An. funestus</i>	6	4	1	0
Total <i>Aedes</i> spp	32	28	06	09
Total <i>Mansonia</i> spp	50	45	38	29

3.2. Origin of blood meal sources in *Culex quinquefasciatus*

Results from the blood meal identification by enzyme-linked Immunosorbent assay (ELISA) revealed that from the 800

females blood-fed of *Culex quinquefasciatus* tested, the majority (88, 5%) fed on human. The remaining fed on goat (6, 5%), beef (4%) and pork (1%) (Table 2).

Table 2: Origin of blood meal sources in *Culex quinquefasciatus*

Areas	Study sites	Nb Tested	Goat	Beef	Human	Pork
			% percentage of fed mosquitoes			
Urban	Founga	200	6%	3, 3	90,1	1.98
	Zountori	200	6,4	3.1	86.9	201
Rural	Nima	200	6.1	3.5	87.8	2.1
	Bougou 2	200	5.8	3.1	88.7	2

4. Discussion

Our results showed seven different species of mosquitoes with PSC method where *Cx. quinquefasciatus* mosquitoes are the most important specie collected. In fact, the low level of urbanization observed in this district seems to be one of the major reason which could explain the diversity of mosquitoes population collected. This situation creates suitable habitats for vector mosquitoes in which there are high number of predators, and human hosts are largely available [23-26]. Similar results were found in southern Benin but with more species [27-29]. However, many studies in West and East Africa and in Europe base on the diversity of mosquito's species showed more species compared to our results. This could be explained by the various methods of adults' collection which were used for mosquito's collection.

Also, most mosquitoes collected was *Cx. quinquefasciatus* in this district. In fact, the low level of urbanization in this district offers good breeding sites for the *Cx. quinquefasciatus* larvae which breeds in polluted water habitats such as pit latrines, soak pits, cesspits and open sewage systems, permanent aquatic vegetation, stagnant water, tires [8]. The predominant of *Cx. quinquefasciatus* as the most abundant species collected during our study confirm previous study conducted in West Africa [30, 31]. Moreover, the identification of blood meal sources in *Cx. quinquefasciatus* in northern Benin showed that most *Cx. quinquefasciatus* population took its blood on human regardless of the sites of collection. The remaining mosquitoes fed on goat and cattle because in this district, the rearing of goats and cattle constitutes an important activity for the population. This result shows that vector control against *Culex quinquefasciatus* in the district of Djougou must take into account the zoophagic behavior of this mosquito.

5. Conclusion

Our findings showed that *Cx. quinquefasciatus* is the dominant mosquito species collected in this district. The high rate of feeding on human by *Cx. quinquefasciatus* could be a potential risk of filarial transmission in this district.

6. Acknowledgement

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7. Conflict of interest

For this work, there is no conflicts of interest

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