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AN APPRAISAL ON OCCURRENCE OF ANOPHELINE SPECIES AS A MARKER OF MALARIA TRANSMISSION RATE IN IRRIGATION SITE IN BUNKURE, KANO NIGERIA

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ABSTRACT
Malaria is an Anopheline mosquito-borne parasitic disease endemic to sub – Saharan Africa, which causes nearly 600,000 deaths every year. The distribution and transmission pattern are known to be affected by the ecological condition of the environment especially water and mesophilic conditions. Accordingly, irrigation-based rice producing system at Bunkure local government area of Kano state, Nigeria was followed up to assess malaria transmission rates. Four hundred and twenty-four (424) adult female Anopheles mosquitoes attracted to man were collected between August, 2010 and January, 2011 in wet and dry seasons in Bunkure Kano State. They were identified with a hand lens and taxonomic keys. The frequency of isolated Anopheline species constitutes 170 (33.2%) Anopheles gambiae and 129 (25.2%) Anopheles funestus for the wet season (August to October) vis-à-vis 72 (32.6%) Anopheles gambiae and 53(23.9%) Anopheles funestus for the dry season (November to January). Anopheline abundance were found in wet season. Mosquitoes that received blood meal were used to determine man biting rate. Blood fed were seen in both mosquitoes' species in irrigation system with man biting rate (MBR) per day, per month and per year 8.03, 240.6 and 2887.2 respectively. It was concluded that Bunkure LGA irrigation system area has high malaria transmission rate. The main entomological factors influenced malaria transmissions were the vector abundance, human blood index and daily survival rate. These factors were influenced by temperature, humidity, rainfall etc. This study provides information required for formulating vector control programmes to curtail malaria transmission in irrigated areas.
Keywords: Anopheles gambiae, Anopheles funestus, Man biting rate, Irrigation, Sites, Malaria transmission.

INTRODUCTION

There are more than 100 species of *Plasmodium* parasite that can infect many animal species such as reptiles, birds, rodents, monkeys and humans (NIAID, 2007). Human malaria caused by genus *Plasmodium* is mainly transmitted through the bite of infected female *Anopheles* mosquitoes during blood meal (Eickhoff, 2011). Four species of *Plasmodium; P. falciparum, P. vivax, P. ovale and P. malariae* have long been recognized to infect humans in nature all of which are transmitted by the female anopheles mosquito. In addition, there is one species; *P. knowlesi* that naturally infects macaque monkeys has recently been recognized as a cause of *zoonotic* malaria in humans (Eede *et al.*, 2009). *Anopheles gambiae* s.l. and *An. funestus* transmit the Plasmodium parasites in sub-Saharan Africa among the human population. Determination of risk of malaria transmission requires quick and accurate methods of identification of Anopheles mosquitoes especially when targeting vector control.

Malaria transmission exits in 99 countries throughout world (FMOH, 2015) and the greater burden of the disease is carried by African countries (FMOH 2015, Ruhago *et al.*, 2011). According to the World Health Organization (WHO), the estimated cases of deaths due to malaria in 2010 were 219 million and 660,000, respectively (FMOH, 2015**)** with malaria deaths steadily decreasing since 1980 in countries outside of Africa. However, inside Africa, malaria deaths in 2004 exceeded those reported in1980, and only a 30% (from 2004) reduction was observed in 2010, which was believed to be associated with the international donor-dependent massive intervention programmes launched after 2004, (Arogundade *et al.*, 2011). Despite the decline in the burden of malaria with the scaling-up of interventions (Pulford *et al.*, 2011), the fact that the estimated (uncertainty exists) number of malaria deaths in 2010 exceeded that of 1980 (Arogundade *et al.*, 2011), calls for more efforts in the prevention and control of the disease in Africa (Ouattara, *et al.*, 2011).

In Nigeria, malaria accounts for 30% - 50% morbidity and 25% mortality in infants (Ajala *et al.*, 2011). The alarming rate at which *P. falciparum* has developed resistance to chloroquine and other synthetic antimalarial drugs makes it necessary to search for more effective antimalarial compounds (Sha'a *et al.*, 2011).

MATERIALS AND METHODS

Sampling of Adult Mosquitoes

Pyrethrum spray collections (PSC) were conducted monthly in ten randomly selected rooms in the village (WHO, 1975; El-Badry and Al-Ali, 2010). Collections were performed in rooms that had not used any form of insecticide or repellent during the previous week. The average number of people sleeping in a room ranged from 1-10 (with a mean of 3). Foodstuff and utensil were removed from the room and a white sheet of cloth 5m x 5m edge spread over the floor and furniture. Insecticide aerosol containing Tetramethrin 0.10%, d-Allethrin 0.010%, and Permethrin 0.02% from a pressurized can (trade mark "BOP") was sprayed inside the room for 5-10 seconds and left with the doors and windows closed for 10 minutes. After the period, the mosquitoes found on the sheet were gathered and handpicked with forceps into petri dishes and they were conveyed to the laboratory for identification using keys of Gillies and De Meillon (1968) with Gullies and Coetzee (1987) into sexed separated by physiological state, unfed and blood fed.

Morphological Identification of Anopheles Mosquitoes

Using morphological characters of Gillies and Coetzee (1987) under x 20 Zeiss light microscope. The identification focused dark spot at the upper margins of the wings which is common to all Anopheles. The palps are elongated and segmented into three. A pale spot on second dark area, a light spot between the two dark spots on vein 6, two dark spots on vein 6 and absence of fringes on vein 6 are features for Anopheles funestus.

Speckles on the legs, third preapical dark area on vein 1 with a pale interruption and tarsi 1-4 with conspicuous pale bands are features for *An. gambiae*. The antennae of the male mosquitoes are always bushy while those of the females are not bushy. *An. gambiae* and Anopheles funestus were of interest in this study.

RESULTS AND DISCUSSION

A total number of 424 female Anopheline mosquitoes representing two species *An. gambiae* and *An. funestus* were collected. *An. gambiae* was the most numerous 242 (57.1%), followed by *An. funestus* 182 (42.9.8%). The wet season catches 299 (70.5%) predominated over the dry season 125 (29.5%). *An. gambiae* constitute the highest during the rainy and dry season (Table1).

The findings of this study showed that both *An. gambiae* and *An. funestus* were found in both seasons, although more of them were found in wet season (Table 1). Both the species were endophagic and were collected indoors. *An. gambiae* were more abundant during the wet season as also observed by (Awolola *et al.*, 2003). The rate of transmission decreases as the rainfall also decrease, this is in line with the finding of Mfonfu (1986). Most of the Anopheles reported in this study were similarly found by *Coluzzi et al*, (2002) in that the most important vector of malaria parasite in SubSahara Africa is *An. gambiae* s.l. It exhibits extreme heterogeneity. This had tallied with this research whereby most of the Anopheles identified were *An. gambiae* s.l. 242 (57.1%) (Table 1). Statistically no significant difference ($p>0.05$) exist between Anopheline in dry and wet season in irrigation system of Bunkure.

The highest man biting rate per month (96.9) was recorded in August during the wet season and lowest man biting rate per month (13.2) was recorded in January during the dry season (Table 2).This is completely in agreement with the findings of (Wanji *et al.*,2003) who found higher sporozoite rates for both *An. gambiae* and *An. funestus* in the wet season than in the dry season in the mount Cameroon region. Number of people slept in the room (49) was higher in September during wet season and (41) was lowest during the dry season November – January. Adequate breeding site during the wet season and inadequate breeding site during the dry season (Table 2).

Comparison between monthly human biting rate of the Anopheles species in Bunkure was carried out using Multi-way analysis of variance (MANOVA). Statistically there is significant difference ($p<0.05$) between man biting rate in wet season (Aug-Oct) than in dry season (Nov-Jan) in irrigation system of Bunkure.

Out of (725) the total Number of mosquitoes collected in this study, Anopheline species account for 424 (58.5%) indicating a high density. Previous studies have also shown that the density of Anopheles mosquitoes is usually very high in irrigation system perhaps due to the environmentally friendly conditions (Awolola *et al.*, 2002).

The finding of this study relating to the link between agricultural practices and mosquitoes breeding are in agreement with the findings of some previous studies. For instance, it was noted in a study conducted in the farming district of South Arcot, India that mosquito breeding in the district was promoted by some agricultural practices (Mouchet and Carnevale 1997). Generally, use of small and large dams for agriculture purposes is known to favour the breeding of mosquitoes in sub-Sahara Africa (Jaywardene, 1995).

The presence of stagnant water on rice farms and the collection of water in ditches and burrow bits constructed during agricultural practices have been reported to be conducive for malaria vector breeding (Vennila, 2004). A study conducted in rural farming communities located in the North Central parts of Ebonyi State, Nigeria, showed that rice farming promoted the breeding of Anopheline mosquitoes in swampy rice farms (Nwoke *et al.*, 2005).

Table 1: Seasonal variation and proportion of Anopheles in Bunkure village Irrigation System Area

Season	n	*An. Gambiae* Indoor (%)	*An. Funestus* Indoor (%)
Wet season (Aug-Oct)	299	170(56.9)	129(43.1)
Dry season (Nov-Jan)	125	72(57.6)	53(42.4)
Total	424	242(57.1)	182(42.9)

Key: n = represents total numbers of anopheles collected per seasons. An = Anopheles
Statistically no significant difference ($p>0.05$) exist between Anopheline in dry and wet season in irrigation system of Bunkure.

Table 2: Biting Activity of Anopheline Genera in Irrigation System Area of Bunkure Village

Month	No of blood fed Anopheles	No of people in 10 rooms	MBR/day	MBR/month
August	100	31	3.23	96.9
September	73	49	1.49	44.4
October	59	45	1.31	39.3
November	38	41	0.93	27.9
December	26	41	0.63	18.9
January	18	41	0.44	13.2
Total	314	248	8.03	240.6

Key: MBR/day = Man biting rate per day, MBR/month = Man biting rate per month
Statistically there is significant difference ($p<0.05$) between man biting rate in wet season (Aug.-Oct.) than in dry season (Nov-Jan) in irrigation system of Bunkure.

CONCLUSION

The irrigation system in Bunkure during the rainy season influences malaria transmission in the area, as indicated by the result of the entomological indices investigated. Irrigation system during rainy season provided optimal condition for the breeding, human biting activity and survival of anopheline mosquitoes thus, significantly enhance malaria transmission during the period. These findings should provide a better understanding of the occurrence of malaria in Bunkure Nigeria and promote the development of informed temporally targeted vector control programs.

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