

STUDIES OF MOSQUITOES IN HADEJIA EMIRATE, JIGAWA STATE, NIGERIA

AHMED, U.A & SANI, ZAKARIYYA

*Department of Biological Sciences, Sule lamido University Kafin Hausa,
Jigawa State Nigeria*

ABSTRACT

Studies on Mosquitoes in Hadejia emirate, Jigawa State, Nigeria revealed the presence of eight species; 107 (16.09%) *Aedes aegypti*, 123 (18.50%) *Ae. africanus*, 41 (6.16%) *Ae. albopictus*, 60 (9.02%) *Ae. furcifer*, 76 (11.43%) *Ae. taylori*, 42 (6.32%) *Ae. luteocephalus*, 77 (11.58%) *Culex decens*, 31 (4.66%) *Cx. dutton* and 82 (12.33%) *Mansonia Africana*. Within the (8) Local Government Areas sampled, Hadejia has the highest member of mosquitoes obtained. *Anopheles* species were only reported from Auyo and Guri has the least number of Mosquitoes *Aedes africanus* was the most abundant while *Anopheles funestus* was the least. The mosquitoes identified in this study are of public health importance and there

Introduction:

Mosquito is a common insect in the family Culicidae. It is a small and mid-like fly. The word "Mosquito" (formed from *Musca* and Diminutive *ito*) is from the Spanish or Portuguese for "Little fly". The two sub-families are *Anophelinae* and *Culicinae* with 41 genera. The four common genera are *Anopheles*, *Aedes*, *Culex* and *Monsonia*. There are about 3500 species of mosquitoes found throughout the world thousands are common in warm climates. Thousands of

is an urgent need to control them by treatment of their breeding places and indoor residual spray.

Keywords: *Aedes, Anopheles, Culex, Mansonia, Mosquito*

Species feed on the blood of various kinds of hosts, mainly vertebrates including Mammals, Eves, Reptiles, Amphibian and even some kinds of Fish. Some mosquitoes also attack invertebrates, mainly Arthropods (Topley, 2008).

In general way, the life cycles of all mosquitoes are much alike, but they differ in terms of morphology, lifecycle, vectoral role and feeding habit. While, males typically feed on nectar and plant juices, the female needs to obtain nutrients from blood meal and body fluid, and are therefore vectors of a number of infectious disease (Jordan and Verma, 2001). They undergo four stages in their lifecycles: Egg, Larva, Pupa and Adult.

The first three stages are aquatic and last for 5-10 days, depending on the species and the ambient temperature. Observation shows that there is a lot of breeding sites for mosquitoes in Hadejia Emirate such as: Dam and irrigation farms in Auyo, Birniwa, Kaugama, Hadejia, Kiri-kasamma and Guri. Surface water is also available all over the emirate during rainy season.

Little is done on studies of mosquitoes in Hadejia Emirate and it only focused on studies on Anopheles mosquitoes transmitting Malaria. This study would seek to study all the existing mosquitoes in the area and its outcome would stand as baseline for further studies and could aid in mosquito control.

LIFE STAGES OF MOSQUITO:

The life stages of all Mosquitoes are very much alike, but they differ in details, Topley, 2008.

EGGS:

Adult female mosquito lays 50-200 eggs per oviposition. The eggs are quite small about (0.5x0.2mm). the eggs are usually oval with various surface markings and in Anopheline, with a peculiar “Floats” of air cells. The eggs are pointed at both ends and have pair of lateral air floats. They lie horizontally on water and owing to surface tension, they form geometrical patterns lying in loose cluster. They are laid directly on water and are not resistant to drying and are hatched within 2-3days; although hatching may take up to 2-3weeks in colder climate.

LARVA:

The larvae occur in a wide range of habitats, but most species prefer clean, unpolluted water. They are in fresh water or salt water marches, mangrove swamps, rice fields, grass ditches, the edges of streams and rivers and small temporary rain pools.

The mosquito larva has a well-developed head with mouth brushes used for feeding, a large thorax and a nine-segment abdomen. It has no legs. It has respiratory siphon except in Anopheles. It breathes through spiracles located on the eighth abdominal segment. It spends most of its time feeding on Algae, Bacteria and other microorganisms in the surface layer. It dives below the surface only when disturbed and they swim either by jerky movements of the entire body or through propulsion with the mouth brushes.

Larva develops through four instars, after which they metamorphose into pupae. At the end of each instars, the larva molts, shedding its exoskeleton, to allow for further growth. First stage larva is about 1mm in length; fourth stage is normally 5-8mm in length.

PUPAE:

The pupa is comma-shaped when viewed from the side. The head and the thorax are merged into cephalothorax with the abdomen curving around underneath, as with the larva, pupa must come to the surface frequently to breath, which they do with pair of respiratory trumpets on its cephalothorax. After a few days as a pupa, the dorsal surface of the cephalothorax splits and the adult emerges.

ADULTS:

Adult mosquitoes have slender body with three sections: Head, Thorax and Abdomen. The head specialized in acquiring information and for feeding. It contains the eyes and pair of long, many segmented antennae. The antennae are important for detecting host odours, as well as odours of breeding sites where female lays eggs. The head also has elongated, forward-projecting proboscis used for feeding, and two maxillary palps. These palps also carry the receptors for carbondioxide, a major attractant for the location of the mosquito's host.

The thorax is specialized for locomotion. Three pairs of legs and a pair of wings are attached to the thorax.

The abdomen is specialized for digestion and egg development. This segmented body part expands considerably when it takes a blood meal. The blood is digested over time, serving as a source of protein for the production of eggs, which gradually fill the abdomen.

The duration from egg to adult varies considerably among species, and strongly influenced by ambient temperature. Adult mosquitoes usually mate within a few days after emerging from the pupal stage. In most species, the males from large swarms, usually around dusk, and females fly into the swarms to mate.

Males live for about one week, feeding on nectar and other sources of sugar. Female will also feed on sugar sources for energy, but usually

require a blood meal for the development of eggs. After obtaining a full blood meal, the female will rest for a few days while the blood is digested and eggs are developed.

The cycle repeats itself until the female dies. While females can live longer than a month in captivity, most do not live longer than one or two week in nature. Their life spans depend on temperature, humidity, and their ability to successfully obtain a blood meal while avoiding host defenses.

DISEASE TRANSMISSION:

Mosquitoes are vectors of a number of a disease-causing pathogens such as: West Nile virus, Plasmodium, Filarial worm, Dengue virus among others. The pathogens cause diseases like: Yellow fever, Malaria, Lymphatic filariasis (elephantiasis), Dengue fever (break-bone fever), Chikungunya, Eastern equine encephalitis etc. (Cheesbrough, 2005).

Members of the *Anopheles gambiae* complex are the most important vectors of Malaria in Sub-saharan Africa. The complex consists of about seven species that vary in their ability to transmit Malaria. *An. gambiae* s.s and *An. arabiensis* are both the most broadly distributed and the most efficient vectors of Malaria (Coetzee et al, 2000). Because of their variable breeding places, taste in blood, extent of travels and willingness to come indoors to bite or rest, different species of *Anopheles* relate differently with humans (Chandler and Read, 1961).

Malaria is a major public health problem and cause of much suffering and premature death in tropical Africa, Asia and Latin America. In many endemic areas, it is becoming increasingly difficult to control because of resistance of the parasite to Anti-malarial drugs and lack of adequate vector control measures (Cheesbrough, 2005).

Aedes is a genus of mosquitoes originally found in tropical and subtropical zones but now found on all continents excluding Antarctica. Some species of this genus transmit serious disease pathogen. *Aedes albopictus*, most invasive species and *Aedes aegypti* transmit viruses that cause westline fever, eastern equine encephalitis, dengue fever, yellow fever and chukungunya.

In Polynesia, the species of *Aedes* is responsible for the transmission of human lymphatic filariasis (Nene et al., 2007).

Culex is a genus of mosquitoes with several species of which serve as vectors one of more important diseases of human, birds and other animals. They transmit pathogens that cause Arbovirus infection, West Nile virus, filariasis, Japanese encephalitis, St. Louis encephalitis and Avian Malaria (Nene et al, 2007).

Mansonia species can be found throughout the world and are considered a significant nuisance to humans and domestic animals. The majority of species exist in tropical regions, but several range into the colder climates. *Mansonia titillans* is known to transmit Venezuelan equine encephalitis. Other species of subgenus *Mansoinoides* also transmit several Arboviruses, but they are primarily important as vectors brugian filariasis in India and South-East Asia. *Mansonia uniformis* is a vector *Wucheraria bancrofti* in Western New Guinea (Syed and Leal, 2009).

MATERIALS AND METHODS

THE STUDY AREA

The study will be conducted in 8 Local Government Areas of Hadejia Emirate, Jigawa State and Table 1. The area is located between latitude 10°N and longitude 9° 45' W. it has a total land area of 953km². By the West, it shares border with Taura, Miga and Jahun Local Government Area, Bauchi state to the East and Yobe state to the

North-East. It shares in its Northern border with Maigatari Local Government Area (David, 2008).

Its topography is generally characterized by undulating land, with sand dunes of various sizes spanning several kilometers. The ancient Precambrian rocks of the basement complex are separated from the younger sediment of the Chad formation by a hydrological divide.

Two seasons may be recognized; dry season (November - April) and Wet season (May - October). The rain starts in May and ends in September. The average rainfall is about 22-40 inches (550-1000mm) and the relative humidity is eight per cent (Zakari, 2006).

The main rivers (figure 1) are Hadejia, Kafin-Hausa, Guri and Kiri-kasamma with a number of tributaries feeding North-Eastern part. Hadejia to Kafin-Hausa River transverses the emirate from West to East through Hadejia - Nguru Wetlands and empties into Lake Chad Basin (David, 2008).

The area lies within the Sudan Savannah with elements of Guinea Savannah. The total vegetation cover is being depleted, making it vulnerable to desert encroachment.

Table 1: Local Government Areas of Hadejia Emirate, Jigawa State-Nigeria.

S/n	Local Government Area
1.	Auyo
2.	Birniwa
3.	Guri
4.	Hadejia
5.	Kaugama
6.	Kiri-kasamma
7.	Kafin-Hausa
8.	Malam-madori

MOSQUITO COLLECTION:

Mosquitoes were collected from 8 Local Government Areas of the emirate across the state between the months of January and February, 2016. Each Local Government was sampled over two days within which both adults, pupae and larvae were collected. Ethical clearance were issued to inhabitants more especially for indoor collections. Random sampling both for larva/pupa and indoor collection were employed.

COLLECTION OF LARVAE/PUPAE:

In each locality, larvae of all types of instars, or pupae or both were collected from breeding sites. These include temporary rain pools, dams, rice fields, among others (David and Jan, 2001). Sample size per locality is not determined and samples from all breeding sites in each locality were fixed.

Using a soup ladle, larvae/pupae together with water they were living in was scooped from breeding site and transfer into a transparent plastic bucket covered with bed netting (1mm x 1mm) at the top to allow exchange of gasses. All the specimens were hand-carried to Sule Lamido University, Kafin Hausa for rearing to adult stage.

REARING OF LARVAE/PUPAE:

The buckets were placed in cages and the net that covered the top of the buckets were removed. The larvae/pupae were fed with ground fish diet powder. The replacement of water is every other day (Mark, 1997). The adults that emerged were prevented from escaping by the cage's bed net.

A light spray with pyrethrin against the net killed the student the adults and make them fell on the white cloth beneath the case. They were removed from the cage and stored in separate eppendorf tubes containing Sulphate for morphological identification.

INDOOR COLLECTION:

Indoor resting adult mosquitoes were collected according to the protocol of Molineaux and Gramiccia (1980). The collection was by Indoor Residual Spray (IRS) technique. The selected houses were visited between 6am and 10am. A sheet of large white cloth (4m x 3m) was spread on the floor in a room for recognition of dead mosquitoes and this was followed by spray of Rambo insecticide. After 15 minutes, the mosquitoes that fall on the sheet were collected and stored separately in Eppendorf tubes containing Copper sulphate as drying agent until required.

MORPHOLOGICAL IDENTIFICATION OF MOSQUITOES

Morphological identification involves the use of light microscope X20 and according to the key of Gillies and Coetzee (1987) and Leopoldo (2000).

RESULTS

MOSQUITO TYPES OF HADEJIA EMIRATE

The mosquito types of Hadejia emirate are eleven species of four genera of mosquitoes namely: *Aedes*, *Anopheles*, *Culex* and *Mansonia*. These include: *Aedes aegypti*, *Ae. africanus*, *Ae. albopictus*, *Ae. furcifer*, *Ae. Taylori*, *Ae. Intecapahlus*, *Anopheles funetus*, *An. gambiae s.l*, *Culex decens*, *Cx. Dutton* and *Mansonia africana* (Table 3.1).

ABUNDANCE OF MOSQUITO TYPES IN HADEJIA EMIRATE

Of the 665 mosquito collected and examined microscopically (table 3.2), there were 107 (16.09%) *Aedes aegypti*, 123 (18.50%) *Ae. Africanus*, 41 (6.16%) *Ae. abopictus*, 60 (9.02%) *Ae. furcifer*, 76 (11.43%) *Ae. taylori*, 43 (6.32%) *Ae. luteocephalus*, 8 (11.58%) *Culex decens*, 31 (4.66%) *Cx. dutton* and 82 (12.33%) *Mansonia Africana*.

The abundance of the mosquito species reported from the Local Government Areas revealed Auyo 102, Birniwa 102, Birniwa 96, Guri 19, Kafin-hausa 139, Kaugama 56, Kiri-kasamma 58, Malam-madori 47 and Hadejia 148.

Table 3.1: Mosquito types of Hadejia Emirate

Genus	Species	Local Government Areas							
		Auyo	Birniwa	Guri	K/hau sa	Kauga ma	K/Kasam ma	M/mad ori	Hadej ia
Aedes	<i>Aedes aegypti</i>	✓			✓	✓		✓	✓
	<i>Aedes africanus</i>	✓	✓		✓	✓			✓
	<i>Aedes albopictus</i>					✓		✓	✓
	<i>Aedes furcifer</i>		✓		✓	✓		✓	
	<i>Aedes taylori</i>		✓		✓	✓			✓
	<i>Aedes luteocephalus</i>	✓	✓						
Anopheles	<i>Anopheles funestus</i>	✓							
	<i>Anopheles gambiae s.l.</i>	✓							
Culex	<i>Culex decens</i>	✓	✓	✓	✓		✓		✓
	<i>Culex dutton</i>						✓		

Mansonia	<i>Mansonia</i>		✓		✓		✓		
a	<i>Africana</i>								

Table 3.2: Abundance of mosquito types in Hadejia

Species of Mosquito	Local Government Areas								
	Au yo	Birni wa	Gu ri	K/haus a	Kaug ama	K/Kasam ma	M/ma dori	Hade jia	Total (%)
<i>Aedes aegypti</i>	15			45	14		15	18	107 (6.09)
<i>Aedes africanus</i>	18	6		38	21			40	123 (18.50)
<i>Aedes albopictus</i>					6		20	15	41 (6.16)
<i>Aedes furcifer</i>		21	7	15	5		12		60 (9.02)
<i>Aedes taylori</i>		17		21	10			28	76 (11.43)
<i>Aedes luteocephalus</i>	16	22	4						42 (6.32)
<i>Anopheles funestus</i>	8								8 (1.20)
<i>Anopheles</i>	18								18 (2.71)

<i>gambiae</i>									
<i>S.l</i>									
<i>Culex</i>	27	10	8	9		13		10	77
<i>decens</i>									(11.58)
<i>Culex</i>						18		13	31
<i>dutton</i>									(4.66)
<i>Mansonia</i>		20		11		27		24	82
<i>Africana</i>									(12.33)
TOTAL	102	96	19	139	56	58	47	148	665(100)

DISCUSSION

Eleven species of mosquito were reported from the study site, namely: *Aedes aegypti*, *Aedes africanus*, *Aedes albopictus*, *Aedes furcifer*, *Aedes toylori*, *Aedes luteocephalus*, *Anopheles funestus*, *Anopheles gambiae s.l*, *Culex decens*, *Culex dutton*, *Mansonia Africana*. The emergence of these species could be attributed to available breeding sites such as: Ponds, Rice field, Dams, Pools, streams, gutters in the study area as stated by Jordan and Verma (2011) that Mosquitoes mostly breed in ponds, swamps, rice fields and grassy ditches. Chandler and Read (1961) similarly stated that, the breeding places of Anopheles and other Mosquito species include practically any kind of water except open sea; some species show very little preference whereas others seem to be unreasonably choosy. Some species breed only in pure, clear water, others prefer filthy water; some breed only in sunlight water, only in shade; some demand quite water, others breed in flowing streams. *Anopheles gambiae s.l* and *Mansonia Africana* breed majorly in temporary ground pools and gutters/drainages.

The abundance of Mosquito species observed in the study area may be due to poor Mosquito control. Jordan and Verma (2011) suggested that, poor mosquito control leads to emergence and continued breeding of it. Our physical observation in the study area should that there was no Mosquito control activities in the area. It is easier and more effective to kill Mosquitoes in their landforms than as adults and sausal methods are used with success: Oiling, panama larvicide and Paris green.

The most abundant species collected from the study sites were members of genus *Aedes*. They were collected from six of the eight sites. This is true for this genus as described by Nene et al (2007) that *Aedes* is genus of Mosquitoes originally found in tropical and sub-tropical zones, but now found in all continents except Antartica. Of this genus, *Aedes africanus* was found to be greatest as compared to other genus observed from the study area. This agrees with findings of Masaningn et al (2014) that who reported that, *Ae. africanus* is greatest in Africa and found on the continent of Africa with exclusion of Madagascar later on rapidly spread globally.

The result also reported *Anopheles funestus* as the least abundant species in the area. This species was only found at one site, Auyo. Similarly, Umar et al. (2014) reported the abundance An. Funestus from Auyo. But in contrast they reported the same species from other sites same for this study. Its absence in other sites according to this study could be attributed to season. The abundance of *An. funestus* is related to rainy season (Umar et al., 2014).

The commonest species reported in this study was *Culex decens*. It was found in all sites with exception or Kaugama and Malam-madori. *Culex decens* is widely distributed in Africa and British. Its distribution is associated with its adaptive behavior and can resist environmental changes. Its resistance to environmental changes could be the reason for its widespread almost all over the study area.

For reason unknown to us, Hadejia was the site with most abundant species and largest member of Mosquitoes. But, we suggest that availability of breeding places in that site to be the reason. Our pre-research observation on breeding site revealed the site has both ponds, dams, pools, rice fields, swamps and gutter/drainages that traditionally allow breeding of Mosquitoes. According to Jordan and Verma (2011), Mosquitoes mostly breed in ponds, swamps, rice fields and grassy ditches.

SUMMARY:

This study on Mosquitoes of Hadejia emirate, Jigawa State, revealed *Aedes aegypti*, *Aedes africanus*, *Aedes albopictus*, *Aedes furcifer*, *Aedes taylori*, *Aedes luteocephalus*, *Anopheles funestus*, *Anopheles gambiae s.l.*, *Culex decens*, *Culex dutton*, *Mansonia Africana* as the abundant species.

CONCLUSIONS:

- *Aedes africanus* was the most abundant species;
- *Anopheles funestus* was the least species
- *Anopheles funestus* and *An. gambiae* were only reported from Auyo;
- The commonest species was *Culex decens*, it was found in all the sites with exception of Kaugama and Malam-madori;
- Hadejia is the site with most species and with the highest number of Mosquitoes.

RECOMMENDATIONS:

The mosquitoes identified in this study are of public health importance and there is an urgent need to clean up gutters and to larvicide the breeding places of the Mosquitoes. Indoor residual spray against adult Mosquitoes is also recommended. With recent re-

emergence of *Zika virus* transmission, there is need to examine the collected samples of *Aedes africanus* for presence *Zika virus*. There is also need to conduct molecular identification of the species collected to reveal the sibling species.

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