

# **Kano State Yellow Fever Entomological Survey Report**

**By**

**Entomologists**

**From**

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## **1.0 BACKGROUND**

A boy of about 13 years of age was presented with fever, jaundice, elevated temperature and other signs of febrile illness in Dala LGA of Kano State. Upon investigation locally, yellow fever was suspected. Samples were collected and sent to Dakar, Senegal where the case was finally confirmed to be a yellow fever case. From investigations carried out, the case had no history of having travelled out of Kano State. If this is the case, it was suspected that the transmission occurred locally by vectors within the boy's vicinity. This informed the decision to conduct an entomological survey in Dala LGA to establish the presence of yellow fever vectors in the area. This survey will then provide a basis for carrying out a yellow fever reactive vaccination in the state.

Yellow fever virus is transmitted by mosquitoes of the Genus, *Aedes*. *Aedes* mosquitoes are both anthropophagous and zoophagous; that is, they blood feed on humans and animals alike. They are diurnal (active during the day) and their peak biting periods are the early mornings and evenings. These vectors breed in both man-made and artificial water containers. These containers include collections in tree cavities, leaf axils, bamboo stumps, rock pools, tin cans, coconut shells, domestic water storage containers, discarded vehicle tyres, broken earthen and ceramic wares. The breeding sites, by their nature, keep the mosquitoes in close proximity to man, facilitating disease transmission. Their eggs which are laid just above water level, can withstand desiccation (dryness) – they can remain viable without water for several months. When water level rises such that the eggs are covered, the viable eggs hatch into larvae and the life cycle continues.

Mosquitoes become infected with the yellow fever virus through a vertical transmission from their female parents (transovarian or vertical transmission) or when they bite an infected person. Transmission occurs therefore with subsequent bites of the mosquitoes. Since the 1951 Yellow fever outbreak in Onitsha till date, only three vectors have been incriminated – *Aedes africanus*, *Aedes luteocephalus* and *Aedes aegypti*. In one outbreak in Delta State, *Aedes albopictus* was suspected to be part of the transmission (WHO, 2005).

## **1.2 GENERAL OBJECTIVE**

To conduct risk analysis of the yellow fever vectors in Dala LGA of Kano State.

## **3. SPECIFIC OBJECTIVES**

1. To establish presence of yellow fever vectors in the LGA.
2. To identify breeding sites of these vectors in the area.

3. To determine the risk status of *Aedes* mosquitoes at Dala communities.
4. To incriminate vectors that harbour the yellow fever virus.

## **2.0 MATERIALS AND METHODS**

### **2.1 Study Area**

Kano state is situated at 12°N, 8.52°E and 484 meters above sea level. The study was conducted in Dala and Ungogo LGAs of Kano State. In the LGAs, Sanka, Dasuayi and Layin Kankare settlements were surveyed.

The local steppe climate influences Kano. There is little precipitation during the year. The climate is considered to be BSh according to the Köppen-Geiger climate classification. The wet season is from April to December (The highest wetness is experienced between April and September); while the dry season is experienced in January, February and March. Mean annual rainfall is about 752mm. Temperature is generally high with mean annual temperature of about 26.1°C. The housing pattern is predominantly Cluster.

### **2.2 Entomological Surveillance**

The Entomological techniques employed in the survey were:

1. Ovitraping
2. Larval Survey
3. Adult Collection Traps
4. Modified Human Landing Catch (HLC)

#### **2.2.1 Ovitrap Setting**

Ovitrap were used to collect eggs of *Aedes* mosquitoes within Dala LGA. A total of 17 ovitraps were set. Each ovitrap consisted of a plastic cup (about 500ml, containing about 200ml of water) 1/3 filled with clean water, lined internally with a strip of white cloth (ribbon) measuring 3cm in width and a length equal to the internal perimeter of the cup. Care was taken to ensure that part of the ribbon was above the water line. Mosquitoes oviposit on the ribbon(s) when they attempt to lay their eggs just above the water line/level. The cups were positioned in shaded and cool areas (even on trees) in the premises of the hospital and another household not far from the hospital. These two locations were chosen because they have trees which provide shade and coolness, conditions usually preferred by the vectors especially in the dry season. Another factor that was considered in the selection of the locations was that children and/or animals would not have access to the ovitraps set in them. After 3 days of setting the ovitraps, they were retrieved and the ribbons removed from the cups and air dried at room temperature. Subsequently, they were viewed under the microscope for the presence of *Aedes* mosquito eggs.

### **2.2.2 Larval Survey**

Larval survey is used to collect immature stages of *Aedes* mosquitoes (artificial and natural container breeders). During the survey, natural habitats such as tree holes and leaf axils, which might harbor immature stages (larvae and/or pupae) of *Aedes* species were inspected to determine their presence or absence. Likewise, artificial containers within households were inspected for larvae and pupae of the vectors. Since the survey took place at the peak of the dry season, in which the vectors are usually very hard to come by due to extreme dryness, as many households as possible (100 households) were surveyed to boost the chances of getting the larvae and pupae. Determination of sample size and the use of random selection to determine the households to survey would have limited these chances and so were not used.

### **2.2.3 Adult Collection Traps**

#### **2.2.3.1 Biogent-Sentinel Trap (BG Trap)**

This trap targets day blood-seeking female mosquitoes. It is used with a proprietary lure (BG-Lure®), which attracts the vectors to the trap. A fan at the Centre of the trap draws mosquitoes in as they fly to it in search of the lure. Two BG-Sentinel traps with lures were set outdoors at two households per day and allowed to run for 12 hours (between 6am and 6pm). This continued for five (5) days, with new households being used each new day. At the end of the period (5 days), the traps were retrieved and examined for the presence of adult female mosquitoes. The *Culex* species collected were sorted, identified and preserved in tubes containing silica gel. The tubes were labeled with date of collection, location and the nomenclature and number of vectors in them. These were later transported to NAVRC laboratory and stored in the Centre's insect museum for future use.

#### **2.2.3.2 CDC UV Light Trap**

This trap targets early night and nocturnal outdoor, blood-seeking female mosquitoes. Two of the traps with lures attached, were set outdoors in the same places where BG traps had been set. They were set in alternation with the BG traps for the same number of days (5 days). They were left to run for 12 hours (6pm – 6am) overnight. The traps were later retrieved and the *Culex* mosquitoes caught were sorted, identified and preserved in well labeled eppendorf tubes. These were later transported to NAVRC laboratory and stored in the Centre's insect museum for future use.

### 2.2.4 Modified Human Landing Catch (Human-Bait).

In the survey, modified human landing catches (protecting body parts instead of the traditional exposure of the legs) were performed in the mornings between 7am and 8am and then evenings between 5:30pm and 8pm (these periods form the peak of the biting activities of most *Aedes* species) in two selected locations. These locations were selected due to the presence of trees and shades which made them cool, making them suitable for *Aedes* mosquito breeding. Each entomologist had a torch light and *Culex* mosquitoes were caught using test tubes. They were subsequently immobilized and preserved in well labeled eppendorf tubes containing silica gel, separated from the mosquitoes by a tiny piece of cotton wool. The mosquitoes were later transported to NAVRC laboratory and stored in the insect museum.

### 2.2.5 Determination of mosquito larval indices

The following larvae indices were used to determine the risk/level of transmission:

**House Index** (HI; percentage of houses with at least one positive container) i.e.

**Container Index** (CI; percentage of all containers with water that are larva and/or pupa positive) i.e.

**Breteau Index** (BI; number of positive containers per 100 houses) i.e.

### 2.2.5 Mosquito identification and Preservation

No adult mosquitoes or immature stages (except eggs) of the vectors were collected. It was very difficult to collect the vectors because the survey was conducted at peak of the dry season in the north.

## 3.0 FINDINGS/RESULTS

### 3.1 Larval Survey

A total of 274 larval containers were inspected in 100 households in Dala (Sanka community, Yalwa ward) and Ungogo (Rijiya Zaki and Yade Kwunya wards) LGAs in Kano state. None of the containers was positive for the immature stages of *Aedes* species.

**Table 1: Containers sampled/inspected for *Aedes* species per community**

S/N	Location	Number of Houses	Types of Breeding habitat								
			Tyre (+ve)	Plastic (+ve) Animal Drinkers	Others	Earthen Pot (+ve)	Rock holes (+ve)	Drum (+ve)	Tree holes (+ve)	Metal (+ve)	Plant axil (+ve)
	Sanka	40	0	0	86	18	0	0	0	0	0

Rijiya Zaki	40	0	0	66	31	0	1	0	19	0
Yade Kwunya	20	0	2	25	24	0	0	0	2	0

**Table 2: Household and Container productivity of *Aedes* species per community**

S/N	Location/Community	Number of houses	Number of houses positive	Number of containers	Number of containers positive	Types of Containers positive
1.	Sanka	40	0	104	0	0
2.	Rijiya Zaki	40	0	117	0	0
3	Yade Kwunya	20	0	53	0	0

**Table 3: Determination of larval indices**

S/N	Location	House index (%)	Container index (%)	Breteau Index
1.	Sanka	0	0	0
	Rijiya Zaki	0	0	0
	Yade Kwunya	0	0	0

High larval Index = House Index  $\geq 5\%$  and/or Breteau Index  $\geq 20$ ;

Low larval Index = House Index  $< 5\%$  and/or Breteau Index  $< 20$ .

**Table 4: Summary of Ovitrap Collection**

Community	No. of Ribbons Set	No. of Positive Ribbons	% of positive Ribbons	Total No. of Eggs
Sanka	17	1	5.8	1

**Table 5: Summary of Human Landing Catch (HLC)**

Mosquito Species	Community	Total
	Koko settlement	
<i>Culex spp</i>	22	22
<i>Anopheles spp</i>	0	0
TOTAL	22	22

**Table 6: Adult Trap Collection**

Community	Type of Trap	Number Set	Mosquito Species Collected	No. of mosquitoes collected
Koko	CDC UV Light Trap	2	<i>Anopheles spp</i>	0
			<i>Culex spp</i>	19
	BG Sentinel Trap	2	<i>Anopheles spp</i>	0
			<i>Culex spp</i>	11

### 3.2 Analyses of Findings

#### 3.2.1 Presence/Absence of Vectors

A total of 17 ovitraps were set and retrieved in Dala LGA, Sanka Settlement over a period of 3 days. Several eggs of *Aedes* mosquitoes were found in one ribbon. Only one of the eggs was viable; the rest were seen to be clearly unviable when viewed under the microscope.

#### 3.2.2 Larval Indices

Generally, larval index is considered low when House Index < 5% and/or Breteau Index < 20. Also, it is high when House Index ≥5% and/or Breteau Index ≥20. However, there are no values for larval indices in this survey because no *Aedes* mosquito larva was collected. Nevertheless, several *Culex* mosquito larvae

were collected in Yade Kwunya settlement, in Ungogo LGA. But since we are determining the risk of transmission of yellow fever, transmitted only by *Aedes* mosquitoes, no larval indices were calculated for the *Culex* mosquito larvae found.

### 3.2.3 Breeding Sites

*Aedes* mosquitoes are known container breeders globally. These containers may vary from natural to artificial, depending on the *Aedes* species involved. Tyres, plastic containers, earthen pots, and animal drinking troughs were found to be the common water containers in the area with the earthen pots being by far the commonest – they made up 65% of all water containers surveyed.

### 3.2.4 Prioritization of Areas

According to the WHO, there are four categories of prioritization. They are:

- i. **Priority 1:** Localities where an outbreak has occurred
- ii. **Priority 2:** Localities with high larval indices (House Index  $\geq 5\%$  and/or Breteau Index  $\geq 20$ ).
- iii. **Priority 3:** Localities with relatively low larval indices (House Index  $< 5\%$  and/or Breteau Index  $< 20$ ).
- iv. **Priority 4:** Localities with no report of the disease and low *Aedes* densities.

Areas that fall under Priorities 1 and 2 are considered high risk areas, while those that fall under Priorities 3 and 4 are considered low risk areas.

### 3.2.5 Risk of Transmission

*Aedes* mosquitoes are usually found in abundance during the rainy season in Nigeria. The population keeps dropping as it gets drier. Despite the fact that the survey was carried out in the peak of the dry season, several unviable *Aedes* mosquito eggs (only one of the eggs was viable) were collected in Dala LGA, proving that *Aedes* mosquitoes exist in the area. This is significant and indicates high risk of transmission because *Aedes* mosquitoes transmit yellow fever transovarially (Barry J. Beaty *et al*, 1979). That is, the virus can pass through all the stages of the life cycle of the vector – from the infected female *Aedes* mosquito

through its egg, larva, pupa and finally to the adult offspring. This adult offspring can equally transmit the virus through a blood meal. Indeed, the risk of transmission is heightened by the fact that even if *Aedes* mosquitoes die out in the dry season, their eggs which can remain viable for a maximum of eight months (Soares-Pinheiro VC *et al*, 2016), hatch when favourable conditions (brought about by the rains) return. If these eggs are infected, then the transmission cycle will continue.

#### **4.0 CONCLUSION**

Despite a thorough investigation which consisted of carrying out intensive larval survey in 100 households; setting CDC UV light traps and Biogent traps in 10 households; setting 17 ovitraps in strategic locations and carrying out Human Landing Catch in various suitable spots, only one stage of development (egg) of the vector was found. Several eggs were found but only one of them was viable. This suggests that *Aedes* mosquitoes exist in Dala LGA. It also points to a possible high risk of transmission of yellow fever in the area.

#### **5.0 CHALLENGES**

The entomological survey was conducted at the peak of the dry season when the vectors are usually in aestivation and therefore, very scarce even in the wetter southern part of the country.

#### **6.0 RECOMMENDATIONS**

Based on the findings, the Team recommends the following:

- i. the health personnel that participated in the two-days training on entomological techniques should cascade the training they received to all LGAs in the state;
- ii. the trained health personnel should repeat the survey in all LGAs in Kano state in the rainy season.
- iii. relevant Ministries, Departments and Agencies of health in the state should coordinate cascading of the training and a repeat of the entomological survey in the state in the right season.
- iv. there should be a massive public enlightenment and sensitization of the populace on the yellow fever vectors, their breeding sites, feeding and resting habits to control the vectors and prevent another yellow fever outbreak in the state.

## References

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