

## Entomological Aspect of Malaria Vector in Khartoum State (2002-2005)

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### Abstract

**Background:** Entomological surveillance is used to determine changes in the geographical distribution and density of vectors, evaluate control programmes, obtain relative measurements of the vectors population over time and facilitate appropriate and timely decisions regarding interventions. This study aimed to present the results of entomological survey conducted in Khartoum State (2002-2005) as part of Khartoum Malaria Free Initiative. It also provides the recent results of the insecticides resistance in the State.

**Methods:** Khartoum State has 24 entomological locations which are sited in the different parts of the state. The Data was taken from 3 successive years, from January 2002 to December 2005. All the 24 locations sampled lay within the malaria area in Khartoum State, mosquitoes were collected and processed following WHO guidelines.

**Results:** *An.araabiensis* was found susceptible to Fenitrothion 1% (100%) and Bendiocarb 0.1% (100%), and possibly resistance to DDT 4% (92.3%), Malathion 5% (83.2%) and permethrin 0.75% (95.1%). The correlation between the abundances of adult density and larval density were found significantly in each year (2002 -2005).

**Conclusion:** Routine surveys for mosquito should be an ongoing function of every mosquito control programme. Entomological surveys aimed to monitor vector density, vector susceptibility to insecticides and to evaluate malaria control programme

**Key words:** Entomological surveys, Adult density, larval density, Insecticides resistance.

### Introduction

Entomological surveillance is used to determine changes in the geographical distribution and density of vectors, evaluate control programmes, obtain relative measurements of the vectors population over time and facilitate appropriate and timely decisions regarding interventions. It may also serve to identify areas of high-density infestation or period of population increase. A number of methods are available for detecting or monitoring immature and adult populations. Selection of appropriate sampling methods depends on surveillance objectives, levels of infestation, available funding and skills of personnel<sup>(1)</sup>.

The basis of every mosquito control program is a comprehensive survey. The survey is used to locate and map all potential larval development habitats, to identify the mosquito species present, and to predict the time and location of effective control strategies. Survey

methods include; wetlands inventories, larval and pupal surveys, and adult mosquito monitoring. Larval and pupal surveys are very effective and efficient in monitoring populations and species content. However, before routine breeding site inspection and larviciding operations can begin, all sites within the proposed jurisdiction must be identified and mapped<sup>(2)</sup>. Mosquito larvae are found in a great variety of habitats. This fact has created a need to develop a number of different sampling techniques to ascertain the presence or absence of immature mosquitoes, and to estimate their numbers<sup>(3)</sup>. The kind of mosquito larvae, one is looking for, will determine the sampling technique to be used. As mentioned earlier, it is important that field personnel should know the preferred breeding habitats and seasonal occurrence of species known or suspected to be present within an area<sup>(4)</sup>.

When searching for mosquito larvae, it is necessary to proceed slowly and carefully. Approach the area to be inspected with caution, as heavy footfalls will create vibrations that disturb larvae and cause them to dive to the bottom. Likewise, avoid disturbance of the water, as this will have the same result. Approach the area to be sampled with the sun in one's face; this prevents shadows which also disturb larvae and cause them to dive. If wind is of significant magnitude dipping should be done on the windward side of the habitat where larvae and pupae will be most heavily concentrated<sup>(5)</sup>.

Mosquito larvae are usually found where surface vegetation or debris is present. In larger pools and ponds, they will usually be confined to the margins and will not be found in open, deep water. Dipping should be done around floating debris, aquatic and emergent vegetation, logs and tree stumps in the water, and grasses around the margins. Look for the presence of larvae and pupae before beginning to dip<sup>(5)</sup>.

The kind of mosquito one is looking for, as well as the type of habitat one is working in, will determine the dipping technique used. If field personnel are familiar with the general breeding habits of the major species found within their county, they will be able to choose the most appropriate technique to obtain the most reliable results.

Several methods are available for sampling adult mosquitoes. It includes sweep netting vegetation and taking landing/biting counts, indoor resting collection and pyrethrum knock down collection<sup>(2)</sup>.

To control mosquitoes in a safe, efficient, and economic manner while preventing damage to humans, wildlife and the natural environment<sup>(6)</sup>.

This task is accomplished through the implementation of a comprehensive plan of integrated control approaches; known as Integrated Mosquito Management (IMM). The plan is based on sound scientific knowledge and makes use of the latest technology, equipment and materials. When brought together these methods furnish a cost-effective level of mosquito suppression needed to protect man and domestic animals from harassment and the disease. This concept means more than simply combining several technological approaches. To successfully control mosquitoes, we must know: Which mosquito species are locally important as the primary source of intolerable annoyance or as vectors of disease? Where the breeding sites of these mosquito species are located? When the mosquitoes are developing in these breeding sites? and when the emergence of adult mosquitoes will take place<sup>(7)</sup>.

This study aimed to present the results of entomological survey conducted in Khartoum State (2002-2005) as part of Khartoum Malaria Free Initiative (KMFI). It also provides the recent results of the insecticides resistance in the State.

### **Methods**

Khartoum State has 24 entomological locations which are sited in the different parts of the state. The Data was taken from 3 successive years, from January 2002 to December 2005. All the 24 locations sampled lay within the malaria area in Khartoum State.

#### *Sampling technique*

**Adult Collection:** Adult female anopheline mosquitoes were collected by spray sheet (room collection or pyrethrum knock down collection). This targeted indoor resting mosquitoes. At each home selected for knockdown pyrethrum, all family members were requested to stay outdoors, all water and

food were removed from the home, and any fires extinguished. White sheets were then placed on the floor of all rooms. The eave perimeter was then sprayed from both the inside and outside with pyrethrum (which contains pyrethroids and synergist). The person spraying outside went a little a head of the inside person to keep the mosquitoes from leaving the house. The inside spray man then also sprayed the inside ceiling area and under tables and chairs. After that, the spray man exited the house and closed the door. After 10-15 minutes, sheets were removed one by one and inspected for adult anophelines and other mosquitoes. A magnifying glass was used to differentiate between female anophelines and other mosquitoes<sup>(3)</sup>. Collection visits took place between 06.00-10.30 hours and 5-10 rooms were examined on each visit<sup>(7)</sup>. The adult collection took place early before the larval collection during the survey.

**Larval Collection:** Anopheline larvae were collected by searching different types of larval breeding sites e.g. various types of permanent water bodies, domestic water basins, small water pools, broken pipes, seepages, tins and tyres, man-made ditches, wells, etc. Using a dipping method described by the WHO<sup>(8)</sup>. All these potential breeding sites were surveyed for anopheline larvae. White iron dippers (5cm depth) were used for collection of larvae. A dipper was used to determine whether anophelines or other mosquitoes were present in a particular breeding site. If they were, the anophelines were then transferred by means of a pipette to a plastic box containing breeding sites water. After all the larvae were collected, they were transferred from the box to a large-zip lock bag and taken to the lab where the larvae were released into another plastic box, fed, and then followed through their development stages. When pupal stages began,

the pupae were transferred to a small container of water that had been placed in a large gallon-size paper carton with a netted top. The carton then served as a cage for the adults when emerged from the pupal stage which used for monitoring insecticide resistance (1-3 days-non-blood-fed emerged adult)<sup>(6)</sup>.

**Identification Procedures:** Distinguishing between males and females is most done by examining the antenna of the mosquito. The male antennae tend to be much hairier than that of the female. The purpose of these hairs is to attract males to females for mating purposes. Males do not attack humans or animals. Males feed only on plant nectar.

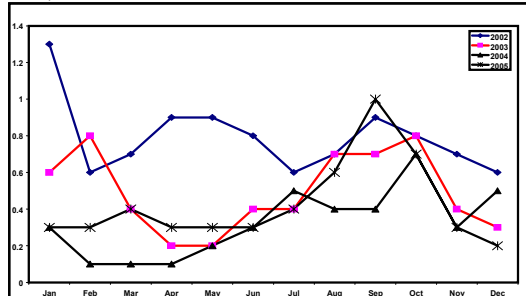
Once you have determined if the mosquito is male or female, it is time to identify it. The first characteristic that should be observed is the length of the maxillary palps as only female species of the Genus *Anopheles* will have maxillary palps as long as the proboscis. The shape of the abdomen is another characteristic used to help identify the genus<sup>(9)</sup>. **WHO bioassay:** These methods include WHO standard susceptibility tests in the laboratory. From these experiments the appropriate dosage required to kill 50% or 90% of populations can be calculated and be able to detect any changes in percentage mortality over a period of time as well as occurrence of resistance in the field. These susceptibility tests thought may be able to tell the inheritance patterns of resistance by crossing and testing progeny, and give a picture of the mechanisms conferring resistance<sup>(10)</sup>.

Ideally, susceptibility testing requires 1-3 days-old unfed female mosquitoes. In the field, this can only be obtained through rearing of collected mosquito larvae. Where this is not possible, collection of adult mosquitoes can be used. Immediately given fresh 5% sugar solution and then sorted out<sup>(11,12)</sup>.

**Results**

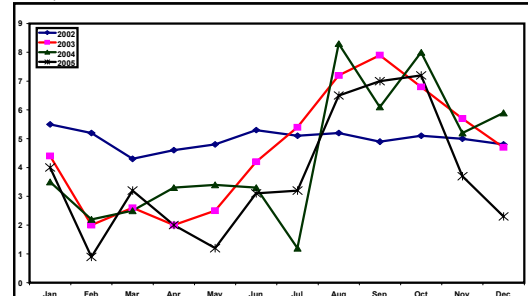
The pyrethrum knockdowns collected are presented in Figure (1), while the larval density collected is presented in Figure (2).

**Figure 1: Monthly An. Arabiensis adult density (2002-2005)**



Adult An. arabiensis responded to different concentration of insecticide are presented in table (1).

**Figure 2: Monthly An. arabiensis Larval density (2002-2005)**



**Table 1: Percentage mortality in field reared larval collection samples of An. arabiensis 24 hours after 1-2 hours exposure to insecticides impregnated papers in WHO test tubes**

Locations	Permethrin* 0.75%	DDT* 4%	Fenitrothion* 1%	Bendiocarb* 0.1%	Malathion* 5%
Soba sharig	96% (125)	80% (50)	100% (115)	100% (75)	92% (25)
Elgrief sharig	96% (200)	92% (150)	100% (200)	100% (175)	87.7% (150)
Elfaki hashim	80% (25)	-	100% (25)	100% (25)	-
Soba Garib	95.6% (275)	-	100% (275)	100% (125)	-
Elshigilab	96% (25)	100% (25)	100% (25)	100% (25)	-
Elsalma algadida	96% (50)	88% (25)	100% (50)	100% (50)	-
Elamir	88% (25)	100% (25)	100% (25)	100% (25)	64% (25)
Shambat	-	-	-	-	70% (50)
Arkweet	-	-	-	-	100% (70)
Gabra	-	-	-	-	90% (50)
Alrimaila	-	90% (50)	-	-	-
<b>Average mortality</b>	<b>95.1% (725)</b>	<b>96% (125)</b>	<b>100% (325)</b>	<b>92.3% (275)</b>	<b>83.2% (375)</b>
<b>Resistance status</b>	<b>PR</b>	<b>PR</b>	<b>S</b>	<b>S</b>	<b>PR</b>

\* WHO diagnostic concentration; S = susceptible; PR = Possibly Resistant.

**Discussion**

Entomological survey in Khartoum State started since 1994 in six locations to assist malaria vector control programme in monitoring vector population density and to guide vector control interventions. During 2002, as part of Khartoum Malaria Free Initiative. The number of locations arises to 24 locations in order to meet the representative sample of the locations. According to our results, the abundances of adult and larval density was found significance when we correlate adult and larval density for each year "p-value= (0.01) 2002, (0.00) 2003, (0.00) 2004 and (0.03) 2005". This attributed whether to the availability of the different breeding sites in the locations (man-made larval habitats), or the suitability of the climatic conditions. This consistent with John C.

Carlson et al<sup>(13)</sup> and also corresponding with Joseph Keating et al<sup>(14)</sup>.The response for An. arabiensis to different diagnostic concentration of insecticides ranged between 83.2-100%. By applying the WHO criteria (98-100%) mortality indicates susceptibility, (< 80% mortality suggests resistance and 80-97% mortality requires confirmation of resistance). It was found that, arabiensis susceptible to Fenitrothion 1% and Bendiocarb 0.1%, because Fenitrothion used early 1970s in Khartoum State as indoor residual spraying .Its never reported any resistance. Bendiocarb (carbamate) considered as anew compounds tested for efficacy to work as alternative insecticide in future. This corresponds with Blue Nile Research Institute 2005<sup>(15)</sup>. DDT 4%, Malathion 5% and permethrin 0.75% was found possibly resistance results, this due to

extensive use in the past and currently in agriculture and domestic use of pyrethroids. These selection pressures against vector population are almost impossible to control. This consistent with Memingway et al<sup>(16)</sup> and Kang et al<sup>(17)</sup>.

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