ANATOMY, BIOLOGY* AND CYTOLOGY OF SOME EGYPTIAN ANOPHELINES

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I - INTRODUCTION

Malaria is a disease that represents a great barrier to social and economic progress in many parts of the world. Therefore, the insects transmitting this disease have been a subject of study for quite a long time .

For the purpose of mosquito extermination, much effort was spent over many years in studying the taxonomy, ecology, physiology, and general biology of the anophelines that transmit malaria. Very recently, attempts were made to study their genetic background. Mosquito control measures used all over the world include the use of several insecticides applied in various ways. Anopheline resistance to some of these insecticides called for the need to understand the biological background underlying the appearance of this phenomenon. Through such a study the gene or genes responsible for developing progressive resistance were identified; and the grade and frequency of resistant strains among natural populations were established. Attention was directed towards a follow up of the development of resistance and detection of the resistant genotypes which may interfer with the control programmes. The chromosome structure was regarded as a valuable marker for detection of resistant strains.

Therefore, it was agreed that the constructuion of standard ohromosome maps for various mosquito species is necessary as a first step in the recognition of chromosomal changes.

The frequent occurrence of malaria in Egypt led many authors to conduct several studies in this topic concerning the main malaria transmitting mosquitoes in Egypt namely Anopheles pharoensis (Theobald) and Anopheles multicolor (Camboulin).

II- AIM OF THE PRESENT STUDY

The present work is devoted to the study of the cytology of Anopheles pharoensis (Theobald) and Anopheles multicolor (Camboulin). The aim of the present study is to add some information about the cytogenetics of these mosquitoes, a contribution which may be of some help in practicing the antimalaria programme.

III - LITERATURE REVIEW

1- Structure, Morphology and Anatomy of the Gonads

Frizzi (1947b) could identify the testes in fourth-stage larvae of Anopheles maculipennis var. atroparvus and Anopheles bifurcatus. He described them as ovoidal structures that lie dorsally at about the level of the sixth abdominal segment. They are usually covered with yellowish pigments which allow their identification through the chitin.

Lum (1961 a) studied the morphology of the reproductive system of some Florida mosquitoes of which Aëdes, Psorophora, Culex, Uranotaemia and Anopheles species. He described the testes as two elongated bodies covered with a coat of colourless fat or with a dark brownish pigmentation.

Detinova (1962) described the adult female reproductive system of mosquitoes including Anopheles maculipennis. This system is composed of two ovaries connected together by two lateral oviducts. Each oviduct is expanded to form an ampulla together with the opposite oviduct and with the common oviduct. A vagina, a spermatheca and an accessory gland were also spotted. In the newly emerged female the ovaries are situated in the region of the fourth and fifth abdominal segments. Inside each ovary there is an internal oviduct into which ovarioles run radially.

2- Metaphase Chromosomes during Mitosis.

Frizzi (1947b) reported three pairs of chromosomes in the female and male gonads as well as in the brain cells of Anopheles maculipennis var. atroparvus and Anopheles bifurcatus. He noticed that two of these pairs are metacentric, while the third pair is subtelocentric in Anopheles atroparvus. However, the third pair was found to be telocentric in Anopheles bifurcatus. In 1953, he described the mitotic chromosome figure of Anopheles claviger and Anopheles quadrimaculatus. He spotted two mediocentric pairs and one acrocentric, dot-like chromosomes.

Kitzmiller and Frizzi (1954) made a survey of the chromosomal complements in several species of mosquitoes. They examined the Italian maculipennis complex : atroparvus , labranchiae, typicus, messeae, subalpinus, melanoon and sacharovi. The mitotic chromosome complement was formed of two pairs of equal metacentric autosomes and one pair of subtelocentric heterosomes, which they assumed to be the sex chromosomes. They are alike in females and unequal in males.

Frizzi and Ricciardi (1955) studied the mitotic chromosome picture of Anopheles aquasalis. They identified the presence of three pairs of metacentric chromosomes, two of which are longer than the third pair. The arms of the third pair are represented by two equal short dot-like structures.

Frizzi and Holstein (1956) reported three pairs of chromosomes in Anopheles gambiae. They include two mediocentric autosomes, and a subtelocentric X-chromosome.

Rai (1963 c) found that a brain cell nucleus of Anopheles quadrimaculatus contains three pairs of metaphase chromosomes. The smallest pair represents the sex chromosomes. They are alike in females and different in males. The other two pairs are metacentric and slightly different in size.

Coluzzi and Sabatini (1969) described the salt water species: Anopheles merus and Anopheles melas of the gambiae complex. The mitotic karyotype of both species includes three pairs of chromosomes. These are represented by a pair of submetacentric autosomes, a second pair of metacentric autosomes and a third pair of dimorphic sex chromosomes. In females of the *merus* species the sex chromosome is heterochromatic in its basal half while its distal part is euchromatic. In males the Y-chromosome to be all heterochromatic. In *melas* species the sex chromosomes are identical to those of the *merus* species.

3- Meiotic Figures

Frizzi (1947 b) could spot a heteropycnotic zone at the periphery of the resting spermatogonial cells of *Anopheles maculipennis* var. *atroparvus*. This zone gave a Feulgen - positive reaction. In leptotene and zygotene stages this mass acquired a filamentous shape and is different in colour from the rest of the chromosomes. Only one part of it remains evident at pachytene, but it disappears completely at metaphase. Metaphase chromosomes appear as three tetrads: one of the autosomes has the form of a ring while the other has a cross-shaped structure. In *Anopheles bifurcatus* the identical heteropycnotic segment is represented by a rudimentary dot.

Kitzmiller and Frizzi (1954) studied the meiotic figures in *Anopheles maculipennis* complex, *Anopheles claviger* and

Anopheles quadrimaculatus. They could spot prophase I, metaphase I and anaphase I in the testes of early fourth-instar larvae. One chiasmata and rarely two were identified per bivalent. They also observed that at anaphase I the sex chromosomes are the first to separate.

Frizzi and De Carli (1954) described a large heteropycnotic zone in meiotic figures of Anopheles freeborni. In Anopheles quadrimaculatus the heteropycnotic zone is insignificant.

4 - Anatomical Structure of the Salivary Glands.

The salivary glands of several varieties of Anopheles were previously studied by many investigators. Certain features were found to be common for all studied anophelines. The salivary glands lie in the anterior part of the thorax of the larva. Each gland is formed of two parts. A small spherical proximal part is situated near the oesophagus and contains 20-25 cells and a large distal sac with 50-60 cells. The two portions are connected by a short isthmus.

Frizzi (1947) ,Canalis et al.(1956), Frizzi and Holstein (1956) and Jensen et al.(1957) found that the morphological structure of the salivary glands of Anopheles maculipennis var. atroparvus, Anopheles gambiae and Anopheles albimanus is identical in the three species of anophelines.

5- Salivary Gland Chromosomes

Frizzi (1947) stated that the salivary cells of the distal sac show ill-defined chromosomes which can not be adapted for a successful study. However, he believed that the voluminous cells of the anterior portion yield a better chromosomal picture.

Canalis et al.(1956) made a comparative study of the salivary complement of the European Maculipennis complex. They found that the salivary chromosomal complement is composed of five arms attached to a chromocenter. They classified them as : a very short X-chromosome, chromosome II with right and left arms, and chromosome III, which is the longest of the chromosomal complement, with right and left arms. They took the shortest limb as the sex chromosome; it is represented by one limb. The other autosomal arms were subdivided into arbitrary zones each bearing one or another specific landmark. They took the chromosomal map of the salivary complement of Anopheles maculipennis