THE LACK OF AUTOLYSIS OF THE FLIGHT MUSCLES OF *Aedes communis* (De Geer) (Culicidae) IN THE LABORATORY

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Many authors have commented on the mystery of the nitrogen source for egg development in the very plentiful northern species of mosquitoes. Surveys of possible blood sources in comparison to the hordes of blood-sucking female mosquitoes have led to the idea that mosquitoes in the north must be capable of developing eggs without blood meals. In my laboratory at Ft. Churchill, Manitoba, Canada, repeated efforts have been made to obtain eggs from blood-sucking females denied a protein food source but maintained on sugar solutions or raisins alone; no instance of egg development or oviposition has occurred.

Hocking, in 1952 reported the progressive autolysis of the flight muscles of a series of field collected specimens of a mosquito believed to be *Aedes communis* (De Geer) from the Ft. Churchill, Manitoba region. The autolysis proceeded as the eggs formed in the ovaries. He postulated the autolysis of these muscles to provide a source of protein for the development of the eggs.

In 1949 (unpublished) I discovered that *Aedes communis* from the Ft. Churchill region was capable of developing and ovipositing viable eggs with a food source of sucrose or raisins alone. Furthermore, no deaths were induced this species to take a blood meal in the laboratory nor were any observations made of positively identified *Aedes communis* females taking blood meals in the field. The specimens Hocking observed were collected, as would be expected with this non-attracted species, in swamps made in the grasses around pools known to breed numbers of *Aedes communis* larvae. The specimens were tentatively identified as *Aedes communis* and there is no reason to believe that they were other than this species.

The reported autolysis was of interest to me, particularly since it appeared to give evidence of a possible egg development without blood in northern mosquitoes, and also because progressive autolysis would afford an admirable opportunity for study of flight characteristics as the muscles disappeared. Therefore in the laboratory, a number of *Aedes communis* females were permitted to emerge from field collected pupae, were fed on sucrose alone, and each day a sample was removed and the living insects were killed and fixed immediately in Carnoy's fixative. The last sample was observed to have fully developed eggs in the ovaries; no eggs being laid in the cages. But some of the gravid females were noted to be capable of flight. The samples were examined for muscle autolysis by sectioning and by gross dissection. No sign of reduction or histological abnormality in the flight muscles was noted, even in the specimens with fully developed eggs. Comparisons were made with the *Aedes communis* newly emerged and with *Aedes hexodontus* Dyar. Figure 1 presents a photograph of an *Aedes communis* female with eggs fully developed and shows a full complement of flight muscles.

Dr. Hocking, by personal communication (1954), has suggested that perhaps the non-autolysing specimens were a different form of *Aedes communis* from those that he observed. In 1950 he showed two peaks in the graph of proboscis to wing length ratio of adult females of *Aedes communis* in the Churchill region and this suggested the presence of two forms. Dr. Hocking has informed me that the proboscis to wing length ratio of the specimens in which he observed autolysis was $0.738 \pm 0.039$. The same ratio for 25 of the specimens showing no autolysis was $0.759 \pm 0.046$. The data shows that the non-autolysing specimens were a different form of *Aedes communis* from those that he observed.
ysis in my laboratory was $0.721 \pm 0.027$. This mean falls well within the same peak as that of Dr. Hocking's and not near the peak of the postulated other form of *Aedes communis* which has its mean at approximately 85.

It appears that autolysis of the flight muscles is not the answer to the development of the eggs in *Aedes communis* in the laboratory. We are left with the “fat body” and the autolysis of other muscles as possible protein sources. Roubaud (1932) has reported the presence of larval muscles in recently emerged *Culex* adults and I have observed similar muscles in *Aedes communis*. These muscles disappear rapidly after emergence, and egg development is noted as the disappearance takes place. Circumstantially one might expect, as suggested by Roubaud, that the histolysis of these muscles contributed some protein for use in egg development. It may actually trigger development. I have sectioned recently emerged *Aedes hexodontus* adults and have observed similar larval muscles. Rapid disappearance is also the case in this species, but the histolysis does not contribute to egg development because no egg development is observed in adults which have not had a blood meal.

Both *Aedes communis* and *Aedes hexodontus* have extensive “fat body” on emergence and whereas *Aedes communis* may use the stored protein from this source for egg development it does not seem to be available to *Aedes hexodontus* without benefit of at least a blood meal.
Fig. 2. A sagittal section of an *Aedes communis* female, recently emerged, showing the dorso-longitudinal flight muscles (dln), the larval muscles (lam), the extensive fat body (FB) and the undeveloped ovaries (OV).

Fig. 3. A sagittal section of an *Aedes communis* female, with eggs (EGS) almost completely developed, with larval muscles absent, with a much reduced fat body but with the dorso-longitudinal flight muscles (dln) intact.
Certainly the physiology of egg production in the two species appears to be quite different. Figure 2 shows a specimen of *Aedes communis*, recently emerged, with dorsal longitudinal flight muscles, larval muscles and extensive “fat body.” Figure shows another specimen of *Aedes communis* with eggs almost completely developed. The dorsal longitudinal flight muscles are present. Of particular interest is the reduction of the “fat body” and the absence of larval muscles which have long since histolysed. The “fat body” of *Aedes hexodontus* also becomes reduced with age; however no egg production takes place without blood. In the blood-sucking species we must still continue to consider blood meals as the most probable source of protein for egg development.

References


—, 1954. Personal communication.


SIMPLE LARVAL AND ADULT MOSQUITO INDEXES FOR ROUTINE MOSQUITO CONTROL OPERATIONS

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Few of the numerous methods used at present to obtain an index of larval or adult mosquito populations in routine mosquito control operations are satisfactory or reliable. While engaged in entomological phases of mosquito control operations in the Solomon Islands in 1943-1945 I used a simple index which appeared to be quite reliable and required a minimum of work for the field personnel. Recently this method has been tried on a limited scale in California with satisfactory results. Therefore it seems advisable to bring it to the attention of persons engaged in mosquito control operations.

It is a well known fact that mosquito populations, both adult and immature stages, are not dispersed at random but occur in concentrations over a wide and variable area. The difficulty with most methods of estimating mosquito populations, such as the popular “average per lip” index for larval populations and the “mosquitoes per hour” or per man-hour for adult populations, is that only one of these variables is taken into account. In developing our simple index we therefore attempted to include both factors of density and extent or spread of the population. Essentially the method consists of standardizing the unit areas to be sampled, measuring the density for each unit area and combining this information into an index. No originality is claimed for this idea but it appears that it has not been widely applied to developing an index suitable for mosquito control operations.

Breeding Index (BI). The breeding index as developed by us is particularly adapted to anopheline breeding in situations where the larval breeding places consist of small, temporary pools as well as streams and other permanent bodies of water, and where there is a considerable fluctuation in the number and extent of breeding sites. With slight modifications