Biology of Aedes aegypti
3. BIOLOGY OF AEDES AEGYPTI

*Aedes aegypti* L. has been used as a model species for the present investigation. The systematic position of the same is as follows:

3.1. The systematic position (Linnaeus, 1762)

- Phylum : Arthropoda
- Class : Insecta
- Order : Diptera
- Family : Culicidae
- Subfamily : Culicinae
- Genus : *Aedes*
- Subgenus : Stegomyia
- Species : *aegypti*

3.2. Life Cycle

In the case of all mosquitoes, completion of the life cycle involves transitioning through four stages: egg, larva, pupa and adult (Fig.3). The egg, larva and pupa represent the immature stages and have an aquatic mode of life. The adults represent the mature stage and lead an aquatic mode of life. The adults represent the mature stage and live in urban and vegetal habitats. These are holometabolous insects, i.e. they undergo complete metamorphosis during their development. Normally, it takes about two weeks to complete their life cycle. They mate during flight. Once mated, the female searches for a blood meal, following which she seeks out a resting place to digest her meal. Once the meal has been digested, the ovaries develop and the female lay eggs.
Figure 3: Life cycle of *Ae. aegypti*
(a) The egg

The eggs of *Ae. aegypti* mosquitoes are approximately 1 mm long and 0.25 mm wide. The hard black shell provides the egg with desiccation resistance and is often sculptured in a species specific pattern. Desiccation resistance is a distinct advantage to storage of the species for longer periods. The eggs of *Ae. aegypti* have a half-life of up to a year if maintained in humid conditions. Eggs are deposited singly on damp surfaces just above the water line. Most female *Ae. aegypti* will lay their eggs in several oviposition sites during a single gonotrophic cycle. Embryonic development is usually completed in 48 hours in a warm and humid environment. Once embryo development is complete, the eggs can withstand long periods of desiccation (more than a year). They hatch once the containers are flooded, but not all eggs hatch at the same time.

(b) The larvae

The larvae are strictly aquatic. The larva goes through four successive moults to reach the pupal stage. The larvae grow from approximately 1.5 to 15 mm long after the third moult. Maximum size can vary from less than 10 mm to more than 20 mm depending on environmental nutrition and other aspects. Under optimum conditions, the larva stage can be as short as 4 days; under starvation condition or suboptimal temperature regimes, they may remain as larvae for months in a diapause state. The duration of larval development depends on temperature, availability of food and larval density in the receptacle.

(c) The pupae

After the fourth larval moult, comma-shaped pupa emerges. Although, it is strictly aquatic, generally it can also survive when exposed to air on moist surfaces. The pupa does not take any nutrition, even though it may be very active in the aquatic milieu. The pupal stage allows the insect to undergo the necessary anatomical and physiological changes that will permit the emerging adult to survive in a terrestrial habitat. Musculature, wings, scales, mouth parts and other internal
and surface structural elements must be formed before this stage is complete. This period lasts 2–3 days, post which the pupa floats to the air–water interface and the adult emerges on the water surface.

(d) The adult

In the first 24–28 hours of adult life, internal developmental continues to complete the transformation to terrestrial life. The main external manifestation of these changes is the complete rotation of the male genitalia. After the genitalia rotation is complete, mating becomes possible. A single mating results in sufficient sperm in the female spermathaceae to last a life time. Females become capable of blood-feeding 2–4 days after emergence. Carbohydrate food sources of sucrose or simple sugars are the required adult maintenance nutrition. Low humidity and lack of carbohydrate source can drastically shorten adult life expectancy.

In most mosquito species, blood is required by the female for egg development. Some mosquitoes are very specific in host selection; others will feed on a broad spectrum of hosts. After blood feeding, the eggs take 3–5 days to develop before oviposition can occur. Selection of oviposition substrate varies, such as soil and tree holes; others may oviposit directly onto a water surface (Munstermann, 1997).

3.3. Ecology of Ae. aegypti

a) Altitudes

Altitude is an important factor limiting the distribution of Ae. aegypti. In India, Ae. aegypti survives in spaces ranging from sea level to 1000 m above sea level. Lower elevations (less than 500 meters) have moderate to heavy mosquito populations while mountainous areas (greater than 500 meters) have low populations. An altitude of 1000–1500 m appears to be the limit for Ae. aegypti distribution, although elsewhere in the world, such as in Columbia, it is found at even higher altitudes, i.e., up to 2200 m (Lozano-Fuentes et al., 2012).
(b) Habitats of larvae

Throughout most of South-East Asia, *Ae. aegypti* oviposits almost entirely in domestic, man-made water receptacles. These include a multitude of receptacles found in and around urban environments (households, construction sites and factories), such as water-storage jars, plates on which flower pots stand, flower vases, cement baths, foot baths, wooden and metal barrels, metal cisterns, automobile tyres, bottles, tin cans, polystyrene containers, plastic cups, discarded wet-cell batteries, drain pipes and ant-traps in which the legs of cupboard and tables often stand. Natural larval habitats are includes tree-holes, leaf axils and coconut shells. In hot and dry regions, overhead tanks, groundwater storage tanks and septic tanks may be primary habitats. In areas where water supplies are irregular, habitats store water for household use, thereby increasing the number of available larval habitats.

(c) Feeding behaviour

*Ae. aegypti* is highly anthropophilic, although it may feed on other available warm blooded animals. Being a diurnal species, females are most active for approximately two hours after sunrise and several hours before sunset, but it can bite at night in well lit areas. The actual peaks of biting activity may vary with location and season. In the case of interrupted feeding, *Ae. aegypti* may feed on more than one person. This behaviour greatly increases the epidemic transmission efficiency. Thus, it is not uncommon to see several members of the same household with disease and onset of the illness occurring within 24 hours, suggesting that they were infected by the same infective mosquito (Platt et al., 1997).

(d) Resting behaviour

*Ae. aegypti* prefers to rest in dark, humid, secluded places inside houses or buildings, including bedrooms, closets, bathrooms and kitchens. Less often, it can be found outdoors, in vegetation or other protected sites. The preferred indoor resting
surfaces are the undersides of furniture, hanging objects such as clothes and curtains, and on walls.

(e) Flight range

The dispersal of adult female *Ae. aegypti* is influenced by a number of factors including availability of oviposition sites and blood meals but appears to be often limited to within 100 meters of the site of emergence. However, recent studies in Puerto Rico indicate that they may disperse more than 400 meters in search of oviposition sites. Passive transportation can occur via eggs and larvae in containers (DAaz-Nieto et al., 2016).

(f) Longevity

In laboratory studies, *Aedes* males and females adults survive 29 and 55 days, on an average, respectively (Shetty et al., 2016). Longevity of mosquito may vary with different environmental conditions.