Persistency of transovarian dengue virus

in Aedes aegypti

INTRODUCTION

Dengue virus (DENV) infection continuously presents a serious health problem in many tropical areas of the world. The disease is hyperendemic in Southeast Asia, where a more severe form, dengue haemorrhagic fever (DHF) and dengue shock syndrome (DSS) is a major public health concern because of the severe and often fatal disease it causes in children (Rohani et al., 1997). Annually, 100 million cases of dengue fever (DF) and half a million DHF occur worldwide. Ninety percent of DHF subjects are children less than 15 years of age (Malange et al., 2004).

In many tropical and subtropical areas, DENV infection is endemic and occurs periodically or annual outbreaks of disease (Gubler and Trent, 1994).

DENVs are transmitted to humans through the bite of infected mosquitoes. For many years, members of the subgenus Stegomyia, especially Aedes aegypti (Linn) and Aedes albopictus (Skuse) have been recognized as the primary vector of dengue (Boromisa et al., 1987; Gubler, 1987; Rohani et al., 1997).

In the absence of a safe and effective vaccine, the prevention and control of DF/DHF are dependent upon the control of the vector mosquitoes. The Aedes control strategy has focused mainly on surveillance for and elimination of Aedes larval breeding habitats and emergency control of adults (Chow et al., 1998).

The cyclic nature of dengue epidemics and how the virus is maintained during inter-epidemic periods in areas, where outbreaks have

Hemma Yulfi: Persistency of transovarian dengue virus in Aedes aegypti, 2006
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occurred previously pose questions, which have led to studies to evaluate the importance of transovarian transmission in DENV maintenance (Lee et al., 1997).

**Dengue Virus**

DENV (serotype I, II, III, IV) are members of the family Flaviviridae. They are plus sense, ss RNA viruses that cause dengue in human. The natural history of the viruses suggest that the viruses are biologically high adapted to the mosquito hosts and they were most likely mosquito viruses prior to becoming adapted to lower primates and humans (Gubler, 1997). The viruses are maintained in a ‘human-mosquito-human cycle’. In addition to the maintenance of dengue virus at the low level of transmission within human population, transovarian transmission is considered to be an important aspect in its maintenance during inter-epidemic periods in species other than its primary vectors (Rodhain and Rosen, 1997).

*Aedes aegypti*, **Principal Vector**

Dengue infection follows the bite of a competent mosquito vector, principally *Aedes aegypti*, infected with one of the four DENV serotypes (Platt et al., 1997). It breeds in stagnant water in all forms of receptacles in urban areas, especially following intermittent rainfall in tropical region (Gubler, 1997).

*Aedes aegypti* is considered to be the primary vector of dengue throughout the world because of its high degree of susceptibility to virus infection and its close association with human habitation (Gubler, 1997). Furthermore, the habits of the mosquito of taking more than one blood meal during a gonothropic cycle can dramatically increase the vectorial capacity.
It has been demonstrated recently that most arbovirus depositions occur extravascularly during probing. Extended period of probing for infected Aedes aegypti would be expected to enhance DENV transmission (Platt et al., 1997).

It has also been shown that susceptibility of Aedes aegypti to DENV is associated with vertical transmission rates, since higher transovarian transmission in a strain could be due to the presence of a higher number of susceptible, infected females (Joshi et al., 2002).

The refractoriness of Aedes aegypti mosquitoes to both Flaviviruses and Alphavirus is a dominant genetic trait. It is known that susceptibility of Aedes aegypti to Flaviviruses and Alphavirus is polygenic and a quantitative trait (Joshi et al., 2002).

**Transovarian Transmission**

Despite extensive research in vaccine development, there is at present no known method of controlling dengue, except by the mosquito vectors. Virologic surveillance, which involves the controlled of DENV infection in human, has been used as an early warning system to predict outbreak (Lam, 1993; Seah et al., 1995). Such surveillance is based on isolation of DENV from human serum by cell culture or mosquito inoculation and type specific identification by immunofluorescent. This approach is less effective since the virus is in the human population. A more effective approach is to detect the virus in the mosquitoes before it is introduced into the human population (Rohani et al., 2005).

One of the great mysteries about the epidemiology of dengue is how the viruses persist during inter-epidemic periods. Recent reports of
transovarian transmission of dengue were documented (Rosen et al., 1998). The demonstration of transovarian transmission of dengue virus in the strain of *Aedes aegypti*, the principal vector, may play a significant role in the maintenance of DENV in nature (Lee et al., 1997). Further study by Maurya et al. (2001) have shown that transovarially infected mosquitoes can orally transmit the virus. The study also suggested that when eggs obtained from infected females after several weeks of incubation at room temperature, the vertical transmission increases. Indicating that prior to summer, if mosquitoes get an opportunity to feed on viremic host and females lay eggs in microniches, where some proportions of eggs survive through the inter-epidemic season, the emerging adults may initiate the ‘human-mosquito-human cycle’. It also envisages the observation in understanding the possible role of *Aedes aegypti* in the maintenance of virus in transovarian passage over different generation (Maurya et al., 2001).

Progeny of *Aedes aegypti* mosquitoes infected with DENV was reared to subsequent generation. For each generation, blood-fed females were confined individually and the eggs obtained from the transovarian infected females were pooled. The seventh generation obtained from the infected parental mosquitoes showed that virus could persist in mosquitoes into successive generations through transovarian passage (Joshi et al., 2002).

Recent study suggests the occurrence of transovarian transmission of DENV by *Aedes aegypti* and *Aedes albopictus*. Infected larvae were recovered from 16 locations (10 in Trengganu, 5 in Kuala Lumpur, and 1 in Pahang). Virus infection rates (VIR) were higher in *Aedes aegypti* (13.7%) compared to *Aedes albopictus* (4.2%) (Rohani et al., 2005).

Information on the ability of the local vectors to transovarially transmit DENV will be useful in assisting the public health personnel and the
general public in implementing a more effective campaign against dengue and the vectors; for if the transovarian transmission of DENV occurs, it is obvious that the control of the immature stages of *Aedes* mosquito and the elimination of breeding sources must be further emphasized and prioritized (Rohani et al., 1997).

**REFERENCES**


