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The effect of cloth wetted with sugar solution and water on prolonging the lifespan of *Aedes aegypti* (Linnaeus) and *Aedes albopictus* (Skuse) under laboratory condition

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Abstract. This study simulates the effects of natural resources, e.g. availability of water and nectar on the lifespan of female *Aedes* mosquitoes. Females of both *Aedes albopictus* and *Aedes aegypti* that were supplied with 10% sugar solution significantly ($P < 0.05$) demonstrated longest lifespan. Compared to those, which were provided exclusively with distilled water. Water deprivation further reduced the maximum longevity of *Ae. albopictus* (5 times) and *Ae. aegypti* (2 times), when compared to those provided with water. Relatively, *Ae. albopictus* demonstrated significantly ($P < 0.05$) longer lifespan than *Ae. aegypti*, except for the starved females. Therefore, *Ae. albopictus* has more chances to encounter human and consequently displays greater capability to transmit disease.

INTRODUCTION

The Southeast Asia region, which is situated in the tropical zone, is a desirable habitat for mosquitoes due to high temperature, high humidity and large area of vegetation. Vector-borne diseases especially classical dengue fever and dengue haemorrhagic fever which are transmitted by *Aedes aegypti* and *Aedes albopictus*, are among the major problem to public health in Southeast Asian countries. In Malaysia the presence of dengue was first reported at Penang Island in year 1902 (Skae, 1902). At present, dengue cases are on the rise from year to year (Lo & Awin, 1984). The Vector Borne Disease Control Program under the Health Ministry of Malaysia, had stated that a total of 14 255 dengue cases were reported in the year 1996, 32 of which were fatal. While in the years 1997 and 1998, a total of 19 544 (50 fatal cases) and 27 373 (58 fatal cases) dengue cases were reported, respectively. The vector distribution area has been increasing during each outbreak (Chan *et al.*, 1971; Yap, 1975; Yap, 1984; Cheong, 1987; Lee & Hishamuddin, 1990).

The ever-increasing threat of dengue fever in the tropical Asian region has prompted the development of various methods to combat the dengue vectors. One of the important non-chemical control methods is environmental management. General description of this control method emphasizes on the elimination of potential breeding sites, such as proper disposal of discarded containers, covering of water containers and concrete filling in tree holes. This is done because eggs of *Aedes* mosquitoes are often found in these natural and man-made containers, both indoor and outdoor but still within the residential compounds (WHO, 1995; Rozendaal, 1997; Lee *et al.*, 1999; Ng & Yong, 2000).

It is known that adults are usually found close to the breeding area (Yap &

Thiruvengadam, 1979; Lee & Cheong, 1987; WHO, 1995; Lampman & Novak, 1996; Kittayapong *et al.*, 1997) and they could feed on plant nectar and damp cloth to survive (Christophers, 1960; Kellogg, 1970; Gadawski & Smith, 1992; Foster & Hancock, 1994; Jahangir, 1997). But elimination of such resources in and around house that could shelter adult mosquitoes is rarely discussed (Rozendaal, 1997; Lee *et al.*, 1999; Ng & Yong, 2000). In Malaysia, it is common sight to see householders hang wet towels, clothes in the bathroom or balcony and having potted plants indoors. Such sites are potential resources in prolonging the survival of female mosquitoes before and after obtaining blood meal.

Normally, lifespan of mosquitoes in the actual field environment is usually shorter than those reared in laboratory, whereby the later mosquitoes are given optimal condition for better survival. The shorter lifespan in the field is caused by the ecological factors that exist in natural mosquito habitat such as dehydration, disease, predation, interspecific and intraspecific competitions (Christophers, 1960; Moskalyk & Friend, 1994; Oda *et al.*, 1999). However, the lifespan of both field and laboratory mosquitoes would be prolonged if they have access to water and food. Quality of nutrient in the food that is available to the adult mosquitoes has a great impact on their physical robustness and behaviour (Khan & Maibach, 1970; Bowen, 1991; Davis & Bowen, 1994; Klowden, 1994; Straif & Beier, 1996). In nature, the average life span for a female *Ae. aegypti* is 15 days and the maximum is 42 days. Meanwhile, for female mosquitoes that are cultured in laboratory under favourable conditions, their average and maximum life span is prolonged up to 76 and 105 days, respectively (Christophers, 1960).

This study attempts to simulate the effect of commonly available damp cloths and nectar of green plant within the residential compound, on the lifespan of female *Aedes* mosquitoes by providing the female mosquitoes with gauze patches soaked in distilled water and sugar solution, respectively.

MATERIALS AND METHODS

The two species of mosquitoes, namely *Ae. aegypti* (Linn.) and *Ae. albopictus* (Skuse) were obtained from the colony of mosquitoes cultured in the Vector Control Research Unit, School of Biological Sciences of Universiti Sains Malaysia. The colony of mosquitoes was established in the Unit for more than 20 years. Both species were breed under laboratory condition [25 ± 2 °C, 70 ± 10 %RH and 12:12 (L:D) photoperiod] using the technique as described by Chong *et al.* (1998).

Experiments were conducted using transparent polyethylene cylinders with lids (d = 12 cm, h = 7 cm). An opening (3 x 3 cm) covered with a piece of bed net (5 x 5 cm) was created at the centre of the lid to allow air ventilation. A piece of gauze patch (4 x 4 cm) was placed in centre of each cylinder. The gauze patch acts as the source of food for the mosquitoes and was treated according to the test regime.

Female mosquitoes that emerged within 6 hours were transferred into nine test cylinders. A total of 10 females were transferred into each cylinder. The nine cylinders were randomly divided to three groups with each group consisting of three cylinders, which represent 3 replicates of a particular group. Each group was supplied with different diet. Group one was not provided with any feeding, group two was only given distilled water and the third group was fed with 10% sugar solution.

The patches of gauze in the cylinders of the first group were left dry while those of the second and third group were wetted with distilled water and 10% sugar solution, respectively. The gauze patches wetted with distilled water and 10% sugar solution represent the damp cloths and plant nectar, respectively. Gauze patches in the second and third groups were maintained wet at all times. Number of mosquito that

was alive was recorded at every 24 hours interval. The observation was continued until all the mosquitoes in the cylinder died. The experiments were conducted under laboratory condition at 27 ± 2°C and 70 ± 10%RH.

Analysis of data

The maximum lifespan of mosquitoes were analysed with one-way ANOVA and Student Newman Keuls (SNK). These statistical analyses were carried out using SPSS version 10.0 (Zar, 1974; Kinnear & Gray, 1997).

RESULTS AND DISCUSSION

As shown in Figures 1 and 3, without any source of feed, both *Ae. albopictus* and *Ae. aegypti* females were only able to live up to a maximum of 4 days. Most of the females (> 90%) died on the third day (Figures 2 and 4). Therefore, total denial of access to any source of feed (water or blood meal) indoor for minimum of 4 days theoretically would fully eliminate all fugitive mosquitoes hiding inside a house. However, Christophers (1960) has reported that *Ae. aegypti* females were able to survive for 7 days without any meals. The difference in methodology and laboratory conditions such as temperature and relative humidity could have resulted in the different lifespan. Furthermore, as described by Lilies & DeLong (1960), mated-females would show longer lifespan compared to the unmated one. They also found that the lifespan of the adult mosquitoes would be shorter if the male and females were cultured separately. In view of these conditions, a follow-up study would be beneficial to re-confirm the maximum lifespan of *Aedes* mosquitoes under starvation.

Results in Figures 1 and 3 showed for both *Ae. albopictus* and *Ae. aegypti* mosquitoes, the presence of gauze patches soaked in water alone, has prolonged their maximum longevity up to 20 and 8 days, respectively compared to those that were starved. Furthermore, as shown in Figures 2 and 4, no death was observed for the first 4 (*Ae. albopictus*) and 2 (*Ae. aegypti*) days. High mean percentage of daily mortality (PDM) for *Ae. albopictus* was observed only at day-5 (36.8%) and day-6 (26.6%) while on the other days, the mean PDM was below 10%. This finding strongly supports Christophers (1960) and Hawley (1988) statements that the availability of water alone would be able to reduce mortality significantly. Therefore, hanging of damp clothes or towels in the bathroom, balcony and kitchen could well support the survival of endophilic mosquitoes such as *Ae. aegypti* inside the house for couple of days. In view of this, control of mosquitoes through source reduction should also emphasize on reducing the access of adult mosquitoes to moist surfaces that could support their lives while waiting the opportunity to obtain blood meal. In tropical countries, the control of access to moist surface in the outdoors may be impractical but in the indoor environment it could be controlled.

Whilst, for the access to gauze patches soaked in 10% sugar solution, results in Figures 1 and 3 show that lifespan of both *Ae. albopictus* and *Ae. aegypti* mosquitoes was further increased significantly ($P < 0.05$). Figure 2 shows *Ae. albopictus* females displayed no mortality during the first 9 days, on the subsequent days the mean PDM was low (< 6.67%) except on day-35. One of *Ae. albopictus* females survived up to day-47 (Figure 1). For *Ae. aegypti*, as shown in Figures 3 and 4 the maximum lifespan was increased to 30 days and no death was observed for the first 11 days. The highest mean PDM was at 16.7% and only observed on day-22 and 24. Overall, results indicate that the access of females *Aedes* to sugar based fluid such as the plant nectar or sap was capable to improve their survival tremendously. These findings suggest that the presence of herbaceous plant inside and around living premises would be a potential source of life support for the endophilic mosquitoes.

Results observed in this study reflect well the findings of previous studies (Christophers, 1960; Lea, 1964; Hylton,

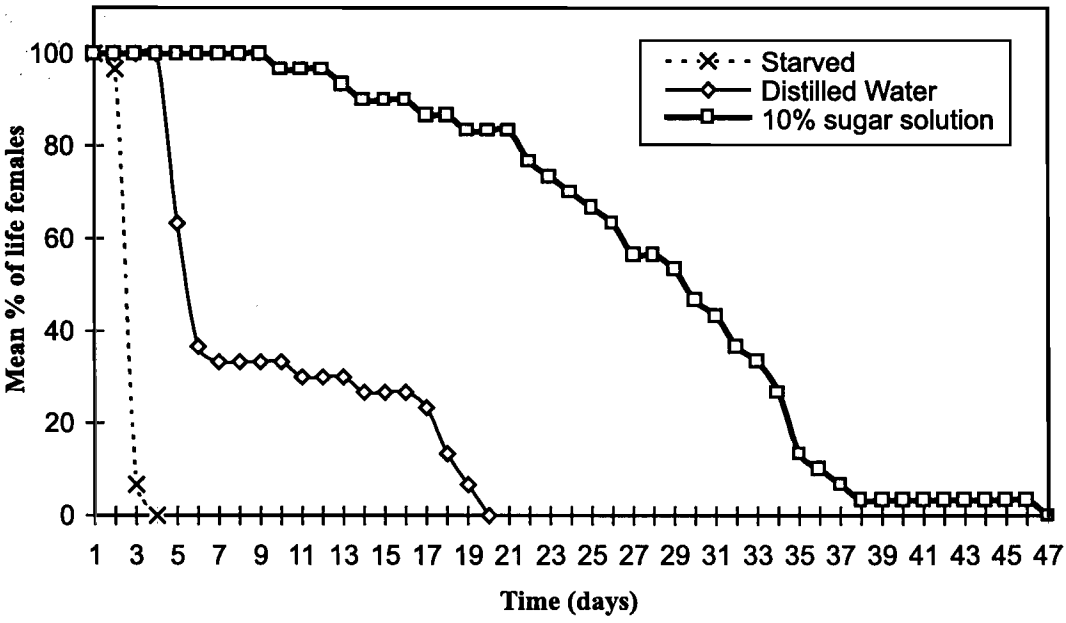

Figure 1. Mean percentage of life females of *Ae. albopictus* against time under different diets.

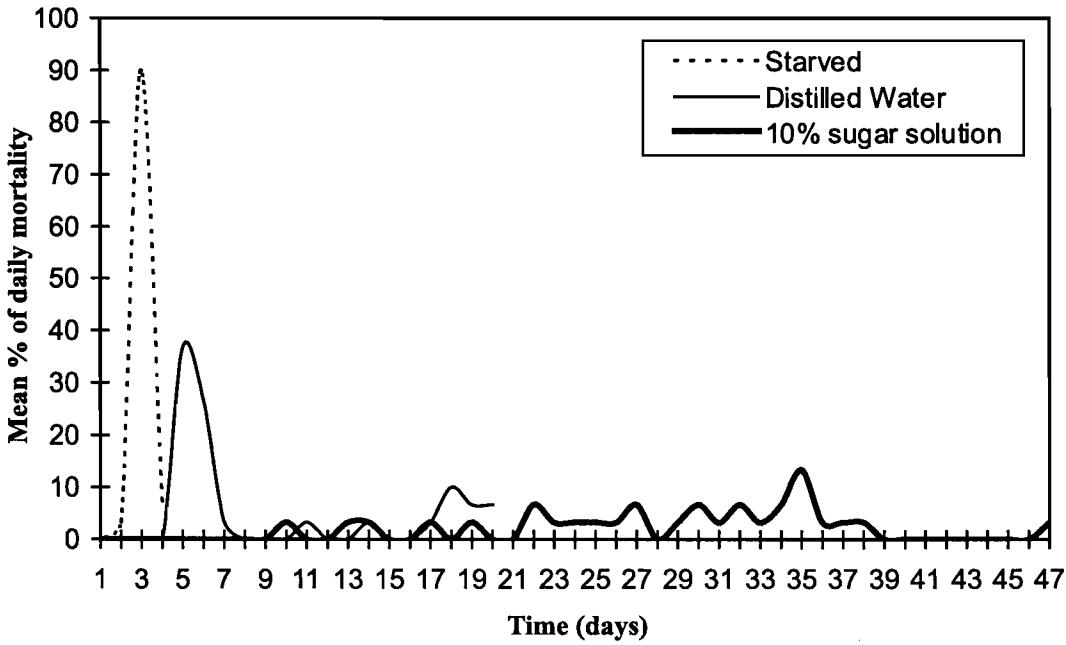

Figure 2. Mean percentage of daily mortality of female *Ae. albopictus* against time under different diets.

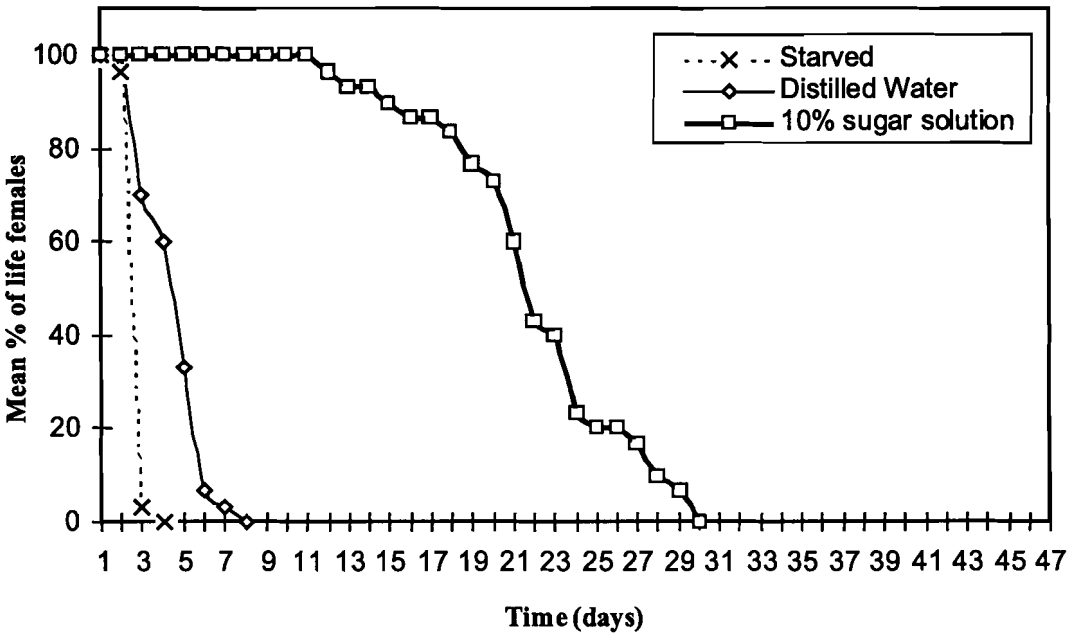

Figure 3. Mean percentage of life females of *Ae. aegypti* against time under different diets.

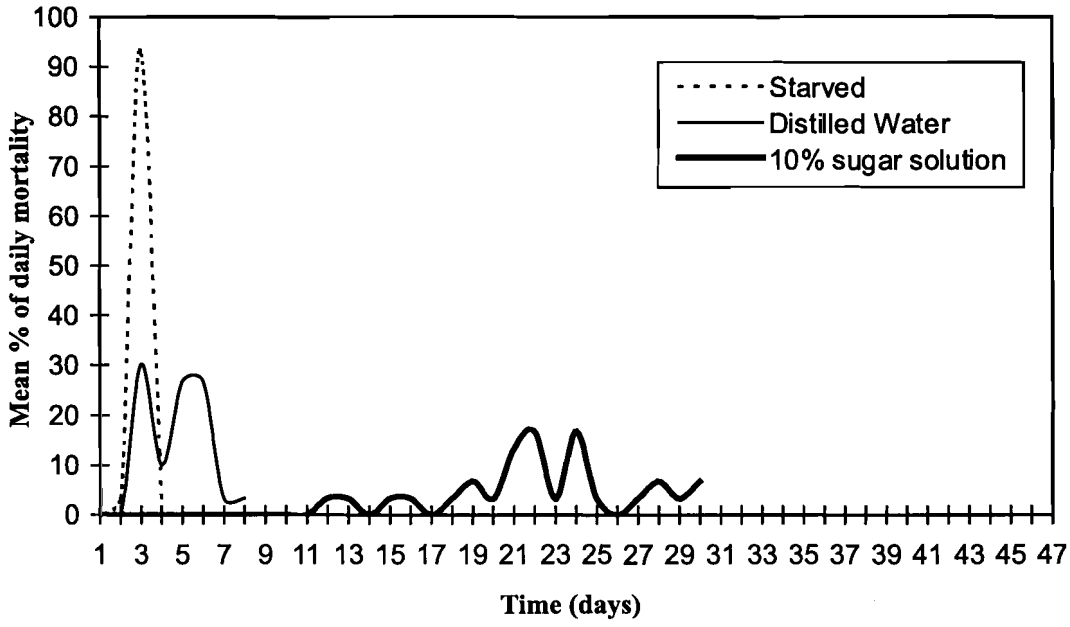

Figure 4. Mean percentage of daily mortality of female *Ae. aegypti* against time under different diets.

1969; Hawley, 1988; Helleck *et al.*, 1993; Straif & Beier, 1996), which suggested that adult mosquitoes supplied with sugar solution would exhibit prolonged lifespan compared to those only given water. While, those provided with water would live longer than those been starved. Principally, findings in this study conclude that presence of water and sugar from damp gauze patches has constructive effect on the longevity of both *Ae. albopictus* and *Ae. aegypti* females. Subsequently, enhances their opportunity to meet blood host and potency to transmit disease. In addition, findings of this study also suggest that *Ae. albopictus* females possess higher survival capability compared to females of *Ae. aegypti*, in view of their maximum lifespan that was 2.5 times longer when supplied with only water.

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