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OCCURANCE OF *AEDES* LARVAE ACCORDING TO COLOUR OF NATURAL WATER STORAGE CONTAINERS IN AMUEHTAN WARD THANLYIN TOWNSHIP, YANGON REGION

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ABSTRACT

Colour preference of *Aedes* mosquitoes on domestic used natural water storage containers survey was done in Amuehtan ward Thanlyin Township, Yangon Region in December 2018. All domestic used major, minor and miscellaneous water storage containers were inspected and recorted for *Aedes* larvae positivity according to natural colours of containers. Result found that a total of 334 water storage containers were inspected 12 kinds of coloured containers were observed in the ward. Of this black coloured containers were found highest distributed number 92(27.54%) followed by blue 48(14.37%), brick 46 (13.77%), darkgreen 45(13.47%) and lowest was observed steel coloured containers 3(0.9%). The highest number of larvae positivity was found in black and blue coloured containers 17(23.94%) followed by darkgreen 10(14.08%) and lowest positivity was found 1(1.41%) in red and green coloured containers. Although yellow, clear and steel containers were found larvae negative. Blue coloured containers in major (44.44%), white and brick coloured in minor (28.57% and 22.72%) and black coloured in miscellaneous containers (78.57%) were found highest larvae positivity. In conclusion black, blue, brick, white and darkgreen coloured containers were found high colour preferences of *Aedes* mosquitoes. Study suggested that yellow, clear, and steel coloured containers are most suitable for water storing. Other highly used water storage containers as black, blue, brick, white and other coloured containers in communities were properly covered to control breeding of *Aedes* mosquitoes.

KEYWORDS: Colour, Container, breeding *Aedes* larvae, Black, Blue, Brick.

INTRODUCTION

Mosquito is prevalent world over especially between latitude 45° north and latitude 40° south and the tropic regions (WHO, 1996). Especially in recent years, the distribution space of both mosquitoes and mosquito-borne disease has been changing and expanding for reasons such as increasing rates of environmental corruption, climatic changes, vector and pathogen resistance to insecticides and drugs, progressive urbanization and population movement (WHO, 1984).

There are three genera of mosquitoes. They are *Aedes*, *Culex* and *Anopheles*. *Aedes aegypti* is one of the world's most widely distributed mosquitoes and is of considerable medical importance. The *Aedes* mosquito is responsible for the transmission of many arthropod-borne viruses (arboviruses), including dengue virus, yellow fever virus, Zika virus, and chikungunya virus (CDCP 2018). These arboviruses pose increasing global public health concerns because of their rapid geographical spread and increasing disease burden. In particular, dengue is the most important arboviral disease, and is widely distributed in the tropical and sub-tropical regions of the world (Rigau-Perez et al., 1998).

The mosquito *Ae. aegypti* usually lays eggs on the oviposition site wall, just above water level, generally in man-made containers that are located around and in the houses. The preferred containers for the deposition of eggs are of large volume (Harrington et al. 2008), dark coloured and contain stagnant water with a low concentration of decomposing organic matter, although the infusion of some plants may have attractive effects (Consoli & Lourenço-de-Oliveira 1994, Colton et al. 2003, Wong et al. 2011). In addition, *Ae. aegypti* females can enhance the development and survival of their immature forms by selecting egg-laying sites that reduce exposure to parasites (Zahiri et al. 1997), predators (Pamplona et al. 2009) and competition (Chadee et al. 1990, Zahiri & Rau 1998, Seenivasagan et al. 2009) or increase access to food (Allan & Kline 1995, Ponnusamy et al. 2008).

Aedes aegypti is a vector of dengue fever (DF), dengue haemorrhagic fever (DHF) and yellow fever (Service, 1992). *Culex quinquefasciatus* transmits: Japanese encephalitis, West Nile fever, Viral arthritis, Polyarthritis and *Anopheles* transmits Malaria (Gordon *et al*., 1962). *Aedes aegypti* is generally thought to be the vector of dengue in more urban areas, so *Ae. Aegypti* is the more important to treat.

Clinically recognizable DHF was first noticed in 1969 in Yangon Children's Hospital followed by the first epidemic in Yangon in the year 1970 (Tun Tun Aung *et al*., 1996). The incidence of DHF increased over the two decades. The spread of DHF from Yangon to other States and Regions started at the beginning of 1975 (VBDC, 1990). High number of dengue haemorrhagic fever (DHF) transmission occurs during raining season from May to October. Water storage practices in Yangon city provide year round breeding opportunities for the vector. In States and Regions, *Aedes* breeding sites become established only in raining season when the locals store rain water for the domestic usages.

In the last 50 years incidence have increased 30-folds with increasing geographic expansion to new countries and in the present decade, from urban to rural setting. An estimated that 50 million peoples are at risk in dengue endemic countries (WHO 2008). In South East Asia and Western Pacific Regions, which bear nearly 75% of the current global disease burden due to dengue (WHO 2009). Dengue Fever and DHF are increasingly becoming serious public health problems in Myanmar especially among the 5-10 and 11-15 years old age groups and now noted 15 years above, a vast majority of the cases occur in 5-8 years old age group (Chusak *et al*., 1998, Hlaing Myat Thu, 2009). In Myanmar, the highest numbers of DHF cases were reported from Irrawaddy, Kachin, Magway, Mandalay, Mon, Rakkine, Sagaing, Tanintharyi and Yangon regions (Tun Tun Aung *et al*., 1996). A severe outbreak of DHF occurred for the first time in Yangon in 1970 (Ohn Khin, 1985). The urban areas within the Yangon Regions limits were more affected than the suburban townships of Yangon Division. This epidemic had an affected mostly school going are groups. Generally more DHF cases predominate during the raining season especially in July and August. Highest number of cases was recorded in July (Ohn Khin, 1985). However, the intervals between dengue outbreaks become shorter in the last two decades. High dengue cases in the raining season correspond to the seasonal high densities of *Aedes aegypti* mosquitoes. Only symptomatic treatment is available for the patients. Preventive vaccines are not yet available commercially.

Aedes aegypti breeds and develops in artificial containers of small volume such as flasks, bottles, flower vases, tin cans, jars, discarded automobiles tyres, unused water closets, cisterns, rain barrels, sagging roof gutters and in natural sites such as coconut shells, snail shells, leaf axils and tree holes (Christophers, 1960). While mosquito breeding habitats can be natural or manmade, Vanek *et al.* (2006), in a study for surveillance of malaria vector larva habitats in Dar es Salaam Tanzania, found out that man-made larval habitats constitute the bulk of vector sources in this urban environment.

Population growth and industrial installation in Thanlwin Township, Yangon Region is necessary accompanied by simultaneous urban development. Therefore, a considerable number of inhabitants living in over crowed periurban districts with unhygienic living conditions provide favourable breeding sites for mosquitoes. In drawing up strategies of *Aedes* control, it is essential that detail bionomic of the mosquito should be studied and clearly understood. As the DHF cases are correlated to the density of *Aedes aegypti* of the locality, factors influencing the seasonal abundance of the vector needed to be studied in detail. Lack of regular water supply and inadequate drinking water supply necessitates water storage appliances and these are potential breeding habitats for *Ae. aegypti* mosquitoes. Owing to population growth, poor levels of hygiene, and increasing urban poverty, the urban environment in many developing countries is rapidly deteriorating. As a consequence, vector-borne diseases are becoming major public health problems associated with rapid urbanization in many tropical countries. Considering the fact that, the species' ecological parameters are subject to changes in time and space, updated information is required so that, it may be used to plan and implement effective control measures against these disease vectors in Myanmar. This study was therefore designed to investigate the current *Ae. aegypti* and *Ae. albopictus* breeding habitats and its habits in relation to coloured of the habitats and potential breeding sources in Amuehtan ward of Thanlwin Township Yangon Region.

MATERIALS AND METHODS

Study area, study sites and study period

Thanlyin Township is situated at Yangon Region. The population of Than Lwin Township is about (268063 persons) in 359km^2 and population density is 746.4 /km^2 in 2014 population Census with high DHF prevalence within the last five years were chosen as study sites. The study site of Amuehtan ward is situated between 96º15'5.38" E and 16.45'57.1"N in Thanlwin Township and population was about 218 people, of this 30 were children in 53 households in Amuehtan wards. In the ward two nursery and day care centers, one pre and one primary schools and one private high school are situated. One ministry school is situated in the ward. The inspected households were chosen randomly in cluster. This study was conducted in December, 2018 in Amuehtan Ward, Thanlwin Township, Yangon Region.

Study design

The study was conducted using non-intervention descriptive field investigation method. All potential breeding sites in suspected high risk areas were examined in order to carry out the systematic study.

Larva positive containers of different container categories and types as well as coloured were recorded and compared with each other. The breeding habitats were divided into major, minor and miscellaneous water containers. Metal drums, concrete tank, concrete jar, glazed or unglazed earthen jars (big bago jar) (size 30 L-100 L), were considered as major containers. Other containers such as small bago jars (glazed jars), water buckets, plastic bowls, flower vases, small glazed earthen bowls and ant-guards were considered as minor containers. Miscellaneous container categories contain discarded utensils (coconut shell, old cans discarded car tires etc.), earthen pots, broken bago jars, tree hole and hollow bamboo pole.

Key containers and Key premises

Larval survey in the selected areas were carried out according to WHO, 1996. *Aedes* larvae positivity in all kinds of water storage containers (major, minor and miscellaneous) were detected and recorded in the study area. Percentage of Key containers (>500 larvae/container) and Key premises (three and above positive containers/house) were calculated.

Identification of specimens

Aedes species identification was done according to Rampa and Prachong, 1994.

Data collection method

Standard sheet for data collection was developed and noted down for the particulars including total water holding containers with water, type of water containers, larva positivity, larva and pupa count and percentages of positive containers.

Statistical analyses

Field data were recorded in appropriate forms and statistical analyses were conducted using Microsoft Excel. In addition comparison in percentage of positive containers in studied area was also used Microsoft Excel.

RESULTS

Table 1: Distribution of different coloured water storage containers in study area and distribution of *Aedes* larvae positivity in different coloured containers.

Colours	Major			Miner			Miscelanious			Total		
	T. Con	+ve Con	% (+ve)	T. Con	+ve Con	% (+ve)	T. Con	+ve Con	% (+ve)	T. Con	+ve Con	% (+ve)
Red	9	0	0	9	1	4.76				18	1	1.41
Black	17	3	8.33	62	3	14.29	13	11	78.57	92	17	23.94
Metal	9	3	8.33	7	3	14.29	0	0	0	16	6	8.45
White	2	1	2.78	21	6	28.57	7	2	14.29	30	9	12.68
Blue	29	16	44.44	18	1		1	0	0	48	17	23.94
Green	10	1	2.78	10	0	0	0	0	0	20	1	1.41
Dark green	44	10	27.78	1	0	0	0	0	0	45	10	14.08
Pink	1	0	0	3	2	9.1	0	0	0	4	2	2.82
Brick	11	2	5.56	33	5	22.72	2	1	7.19	46	8	11.27
Yellow	0	0	0	4	0	0	0	0	0	4	0	0.00
Clear	0	0	0	7	0	0	1	0	0	8	0	0.00
Steel	0	0	0	3	0	0	0	0	0	3	0	0.00
	132	36	100%	178	21	100%	24	14	100	334	71	100.00

Table 1. Shows detail distribution of different coloured water storage containers (Major, Minor and Miscelanious) containers and *Aedes* larvae positivity in different coloured water storage containers in study area and results revealed that a total of 334 different coloured containers were used in study area. Of this the highest number of Black coloured containers (n=92) were used in study area, followed by Blue and Brick coloured containers (n=48 and 46), the lowest was observed steel containers (n=3) in study area. *Aedes* larva positivity was observed the highest in Black and Blue coloured containers n=17 (23.94%) each followed by Concrete coloured containers n=10 (14.08%), the lowest was observed Red and Green coloured containers n=1(1.41%) each. Although Yellow, Clear and Steel coloured containers (n=4,8 and 3) were found no *Aedes* larvae.

In major containers the distribution of coloured containers were found the highest number of Concrete containers were (n=44) followed by Blue coloured containers (n=28) and lowest coloured container was observed Pink coloured (n=1). Larva positivity was highest in Blue coloured containers (n=15) 42.85% were positive for *Aedes* larvae followed by Concrete containers (n=10) 28.57% and lowest positivity was found in White and Green coloured containers (n=1)2.86% each. Although Pink and Red coloured containers have not found *Aedes* larvae positivity.

In minor containers a total of 179 water storage containers in 12 coloured containers were inspected. Of this the highest number of black coloured containers (n=62) were recorded, followed by ground coloured containers (n=33) and lowest was observed concrete container (n=1). Larva positivity was found highest in white coloured containers n=6(27.25%) followed by Ground coloured containers n=5(22.72%) and lowest was found in red coloured container n=1(4.55%). Although green, yellow, clear, steel and darkgreen coloured minor water storage containers in study area have not found larva positive.

A total of 24 miscellaneous containers consist of 5 different coloured water storage containers were inspected for *Aedes* larvae positivity. The highest number of black coloured water storage containers n=13 were recorded followed by white coloured containers n=7 and lowest was observed blue and clear coloured containers. Of this black coloured miscellaneous containers n=11(78.57%) were found highest *Aedes* larvae positivity followed by white coloured miscellaneous container and lowest was observed brick coloured miscellaneous containers. Clear and blue coloured containr were found no larval positive in the stud period.

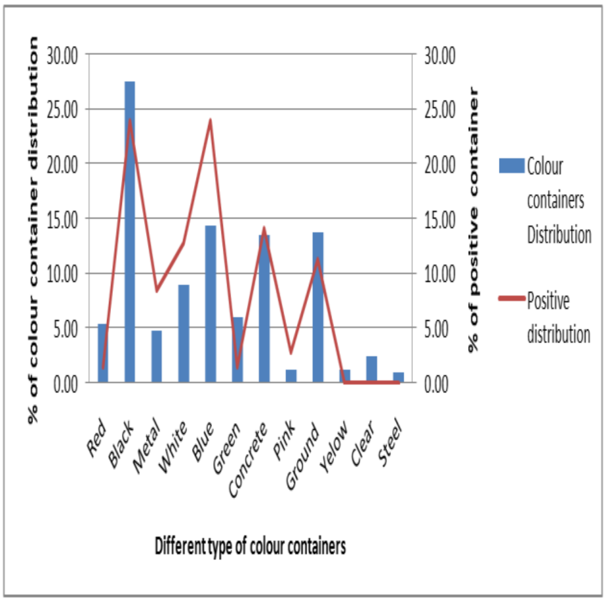

Fig. 1: Percentage distribution of different coloured water storage containers in study area and distribution of percentage positivity in different coloured containers with *Aedes* larvae.

Figure 1. shows that the highest percentage of distributed coloured containers was found black coloured (27.54%) followed by blue coloured water storage containers(14.37%) and lowest was observed steel water storage containers (0.90%). And also concrete, brick and white coloured water storage containers were used in high density i.e. 45(13.47%), 46(13.77%) and 30(8.9%) respectively.

Aedes larval positivity in different coloured water storage containers were found highest in black and blue coloured containers 23.94% and 23.94% followed by concrete water storage containers 14.08 % the lowest was found in Red and Green coloured containers 1.41% and 1.41%. Other coloured containers as 14.08% of White, 12.68% of Concrete and 8.45% of Metal coloured containers were found high laval positivity. No larvae were found positive in Yellow, Clear and Steel containers in the study ward.

Table 2: Key containers of water storage containers and key premises of households in Amuehtan Ward in Thanlyin Township.

Key containers	Key premises
16	10
4.79%	18.17%

Key container=500 & above larvae positive container, Key premises =3 & above containers positive with larvae.

Table 2. shows that 4.76% Key containers and 18.17% Key premises were found in Amuehtan Ward in Thanlyin Township.

DISCUSSION

Mosquitoes are the single largest group of insects, which serve as intermediate hosts in the transmission of many important human diseases as malaria, dengue fever, yellow fever and filariasis. Many mosquitoes will lay their eggs in damp soil; the eggs will hatch when flood waters cover them (Seng & Jute 1994). *Aedes aegypti* mosquito usually lays their eggs on the oviposition site wall, just above water level, generally in man-made containers that are located in and around households of the cities (Fay & Perry 1965, Reiter 2007).

Diurnally active mosquitoes are believed to have a better developed color sensitivity than crepuscular or nocturnally active species (Allan et al. 1987). Both species prefer to oviposit in late afternoon, with environmental conditions sometimes modifying the hour of oviposition to an earlier time of day (Haddow and Gillett 1957, Tsuda et al. 1989). Thus, color and/or contrast could play an important role in container choice among gravid females. While *Ae. albopictus* is believed to have originated as a tree hole breeder from the tropical forests of Southeast Asia (Watson 1967), it has adapted well to artificial containers commonly found in suburban and urban areas. Both *Ae. albopictus* and *Ae. aegypti* oviposit readily in manmade containers, and the selection of black ovitraps used to monitor populations was based on their preference to oviposit in small black or dark water-holding containers resembling tree holes or rock cavities (Hawley 1988).

In the present study colour preference for breeding of *Aedes* mosquitoes was studied in different natural coloured water storage containers in selected area. A total of 334 different containers (Major, Minor and Miscelanious) were used for water holding in randomly selected households, of this 12 coloured containers were observed. Of this the highest number of black coloured containers were used in study area, followed by blue and brick coloured containers, the lowest was observed steel containers in study area. For diurnally active artificial-container breeders such as *Aedes aegypti* (L.) and *Ae. albopictus* (Skuse), vision undoubtedly influences oviposition site selection; however, little is known of the degree to which the visual parameters of colour and contrast influence oviposition site selection of either species. *Aedes* larva positivity was observed the highest in black and blue coloured containers followed by Concrete (darkgreen coloured) containers, the lowest was observed red and green coloured containers. Although yellow, clear and steel coloured containers were found no *Aedes* larvae.

In major containers the distribution of coloured containers were found the highest number of darkgreen coloured containers followed by blue coloured containers and lowest coloured container was observed pink coloured. In minor containers a total of 179 water storage containers in 12 coloured containers were inspected. Of this the highest number of black coloured containers were recorded, followed by brick coloured containers and lowest was observed darkgreen containers. A total of 24 miscellaneous containers consist of 5 different coloured water storage containers were inspected for *Aedes* larvae positivity. The highest number of black coloured water storage containers were recorded followed by White coloured containers and lowest was observed blue and clear coloured containers.

Vision plays a principle role in adult mosquito biology, including location of hosts, food sources, mates, resting sites, and oviposition sites (Allan et al. 1998). A great many studies have examined the visual parameters of shape, size, contrast, light intensity, texture, and color attraction to host seeking mosquitoes, while few studies have explored which of these parameters are attractive to gravid adult females (Hawley 1988).

In major containers (>50 garlands) Larvae positivity was highest in blue coloured containers were positive for *Aedes* larvae followed by darkgreen coloured containers and lowest positivity was found in white and green coloured containers. Although, pink and red coloured containers were found *Aedes* larvae nagative. A different type of colour preference study revealed that blue cloth was more attractive for gravid females than for host-seeking females. Gilbert and Gouck (1957) found that the resting preference of *Ae. aegypti* for colored paper disks was yellow, orange, and red, while green, blue, and white disks were less attractive.

In the present study minor containers (<50 garlands), larva positivity was found highest in white coloured containers followed by brick coloured containers and lowest was found in red coloured container. Although green, yellow, clear, steel and darkgreen coloured minor water storage containers in study area have not found larvae positive.

In miscellaneous containers (0.5-10 garlands) black coloured were found highest *Aedes* larvae positivity followed by white coloured miscellaneous container and lowest was observed brick coloured miscellaneous containers. Clear and blue coloured containers were found no larval positive in the stud period. Behavioral choices of female mosquitoes are clearly affected by color, either as a substrate or as light. Snow (1971) surmised that *Ae. aegypti* were most sensitive to green–orange light (470–610 nm) and thus avoided those colors while seeking more cryptic oviposition sites. In a laboratory study observed that host-seeking *Ae. aegypti* favored landing on black or red cloth over yellow cloth (Brett 1938). Blue cloth was more attractive for gravid females than for host-seeking females. Gilbert and Gouck (1957) found that the resting preference of *Ae. aegypti* for colored paper disks was yellow, orange, and red, while green, blue, and white disks were less attractive. They also noted that *Ae. aegypti* females were more attracted to the darker shades (less illumination) of each of these colors. While host-seeking and gravid adults sought different colored targets (Brett 1938, Snow 1971), both studies reported that dimly lighted targets were preferred to brightly lighted ones. Yap (1975) found that gravid *Ae. albopictus* in rural Malaysia oviposited more in red and black ovitraps than in blue, yellow, green, white, and plain (unpainted) ovitraps. Later, in laboratory studies gravid female *Ae. albopictus* laid significantly more eggs in black, red, and blue ovitraps than in green, yellow, white, or clear (unpainted glass) ovitraps (Yap et al. 1995), which correlated well with Snow's findings for color preferences of gravid *Ae. aegypti*.

In the present study *Aedes* larvae positivity was observed the highest in black and blue coloured containers (23.94%) in major followed by, black coloured containers in minor and miscellaneous containers followed by black coloured containers in major, white coloured in minor and miscellaneous containers. Although pink, yellow, clear and steel coloured containers were found no *Aedes* larvae. Other researchers revealed that black coloured containers were found higher level of *Aedes albopictus* larvae positivity in outdoor and white and red colour containers were found high level of *Aedes aegypti* larvae positive in indoor (Maung Maung Mya et al., 2017). Although *Aedes* gravid the preferred containers for the deposition of eggs are of large volume (Harrington et al. 2008), dark coloured and contain organic matter, zooplankton, phytoplankton, bacteria and some water plants may have attractive effects (Wong et al. 2011, Maung Maung Mya et al., 2013).

Other research observed that gravid females responded more strongly to oviposition targets illuminated by blue–green light (360 nm, 500 nm) than to targets illuminated with green–orange light (470–610 nm), and it was concluded that females detected both ranges of light but preferred the darker, less reflective blue–green targets than the brighter green–orange targets. Spectral reflectance measurements of black and blue containers produced both narrower ranges of visible color and lower reflectance (counts) than either orange or white containers. Because the latter had the highest intensity of spectral reflection and the broadest range of reflected light, they were the least attractive to gravid *Ae. albopictus* and significantly fewer eggs were collected compared to black containers with low spectral reflectance (Hoel et al., 2011). Snow et al., (1971) found that the higher attraction to black ovitraps with lower spectral reflectance compared to blue, orange, and white ovitraps. Same result has been observed in the black containers of the present study were highly larvae positivity. In an experiment by same researcher observed that black ovitraps outperformed competing colored and contrasting patterned ovicups with respect to choice from gravid *Ae. albopictus* seeking artificial oviposition sites.

Mosquitoes are the single largest group of insects, which serve as intermediate hosts in the transmission of many important human diseases as malaria, dengue fever, yellow fever and filariasis. Dengue Fever mosquito breeding grounds is differ in different water storage containers with pure water such as old tires, flower pots, aluminum cans, bird baths, rain gutters, tree holes, that can hold even small amounts of water and many other items as plastic drums, metal drums, concrete tanks, concrete drums, concrete jars, spirit bowls, bago jars that can hold even large amounts of water. Many mosquitoes will lay their eggs in damp soil; the eggs will hatch when flood waters cover them (Seng & Jute 1994). The mosquito *Ae. aegypti* usually lays their eggs on the oviposition site wall, just above water level, generally in man-made containers that are located in and around households of the cities (Fay & Perry 1965, Reiter 2007).

In the present study 16(4.79%) key containers were found in Amuehtan Ward in Thanlyin Township Yangon Region. Same study in Pakakku revealed that 2 concrete jars (green colour) and 1 concrete tank (darkgreen colour) in major, 2 earthen pots (brick colour) in minor and 1 earthen bowl (black colour) in miscellaneous respectively (Zin May Htet 2018). A recent study in pakakku Township found that seven Key containers (over 500 larvae positive container) five in major containers (one big bago jar, one metal drum, one plastic drum and two concrete tanks) and two in miscellaneous containers (two hole of tree stems which were used as food pat of cattle) were recorded in Sin Lan village and six Key containers in major containers (five metal drum and one water cleaning tank) were recorded in Anout Taw village (Moe Kyaing 2017). Than Than Kyi (2015) also revealed that big bago jars are highly key containers of *Aedes* larvae in Hpa-an Township and one of the bago jar which was used for preservation of Thittothi in Taung Nar village was found with plenty of *Armijaris* and *Culex* larvae but in the study areas of Pakokku there were not found any preservative containers. Although in some containers *Aedes* larvae were found co-breeder with *Culex* larvae in small concrete tanks, black plastic bowls and earthen pots which containers were used in Toilets. Other researchers mention that metal drums, concrete jars, spirit bowls and bamboo stems were found key containers in Yangon Region (Tun Lin, *et al*., 1995, Pe Than Htun, *et al*., 2010 Maung Maung Mya, *et al*., 2005). Metal drum and bago jars are highly positive for *Aedes* larvae and metal drums are regarded as key containers in Tha Key Ta, Shan Chaung and Dagon North Township, Yangon Region (Maung Maung Mya, *et al*., 2011, Tun Lin, *et al*., 1995, Maung Maung Mya, *et al*., 2013). A study of Than Than Kyi (2015) in both Mingalar Ywar Thit and Taung Nar villages, in Hpa-an Township, some major containers such as concrete tanks, metal drum and concrete jars were found positive with Aquarian fishes and dragonfly nymphs. Those containers were found absent of *Aedes* larvae. In present study there was found predators as Dragon fly nymphs, *Taxorhynchities* larvae and larvivorus fish in some larva absent concrete tanks, Bago jars, Concrete jars Metal drums, Car tyre and other containers in outdoor of the households. Other researchers also revealed that dragonfly nymphs were mostly found in concrete tank, concrete jars and some metal drums (inner surface covered with cement) and ponds in outdoor of the households in Yangon Region which nymphs are highly predator of mosquito larvae (Sebastian, *et al*., 1990, Maung Maung Mya, *et al*., 2013).

Most of the major containers were found as Key containers in the study areas such as concrete tank (darkgreen), Concrete jars (darkgreen), Metal drum(green), Plastic drum (black and blue), Spirit Bowl (black), discarded Bago jar (darkgreen) and Tyre (black) in outdoor of houses. *Aedes aegypti* and *Aedes albopictus* larvae were observed co-breeders in the Key container of Concrete jars (darkgreen), Bago jars (darkgreen) and Car tyre (black). Although both *Aedes* larvae were co-breeders in the Key containers of manmade three hole was found in Hpa-an Township Kayin State (Than Than Kyi, 2015) Same observation of *Aedes aegypti* and *Aedes albopictus* larvae were observed in a spirit bowl in Hmawbi Township, Yangon Region (Maung Maung Mya, *et al*., 2005). A similar study done by other researcher in Insein Township revealed that *Aedes* larvae were bred together with *Toxorhynchites* larvae in car tires. *Toxorhynchites* larvae were easily found in unused Bago jars (darkgreen), earthen pots (brick) and discarded old car tires (black) (Myint Myint Chit, 2009) and mostly they were found together with *Aedes* larvae due to the fact that they are predators of mosquito larvae (Chuah &Yap 1984). Present study observed that *Toxorhynchites* larvae and Dragon fly nymphs were abundantly present in major water storage containers in outdoor condition. And miscellaneous containers Car tyres were found highest positivity in present study although a study in Thailand revealed that miscellaneous containers outdoors show significant variation, the greatest number occuring in the wet season (Tonn et al., 1969).

In the present study high percentage (18.17%) of Key premises houses were found in outdoor condition in Amuehtan Ward in Thanlyin Township. Although researcher revealed that high number of Key premises 56(70%) were observed in indoor of households in ward 6 in Pakakku. Mostly larva were positive in Concrete tank, Concrete jars, earthen pot, earthen flower pot, Bago jars and some discarded earthen pot(Zin May Htet 2018). The results of the present studies study was agreed with the results of other researchers they had found high number of Key premises and Key containers in Tha key Ta Township, North Dagon Township and Shwe Pyi Thar Township in raining season (Htin Zaw Soe, *et al*., 2004, Maung Maung Mya, 2005, Myint Myint Chit, 2009. Tin Maryi Tun, (2007) mentioned that in pre-monsoon survey, 62.19% of major containers were positive for *Aedes aegypti* larvae in North Dagon Township followed by 50% of Pazundaung area. Percentage of positive miscellaneous containers of Latha Township was higher than that of other Townships and the highest percentage of Key premises (70.59%) was found in North Dagon in post monsoon period in Yangon Region (Tin Maryi Tun, 2007). A recent study by Than Than Kyi (2015) revealed that 22(44%) Key premises of Taung Nar village was higher than 7(19.61%) Key premises of Mingalar Ywar Thit village in monsoon period. Same result of key premises has been found in Tha Kay Ta and North Dagon Townships in Yangon Region (Htin Zaw Soe, *et al*., 2004, Tin Maryi Tun, 2007, Maung Maung Mya, *et al*., 2013). In the present study larval positivity in water storage containers, Key premises and Key containers were higher in Amuehtan Ward in Thanlyin Township, because most of the water storage containers were without covered and full with water.

In the present study gravid *Aedes* mosquitoes laid their eggs in metal drum, Plastic drum, Concrete tank, Big Bago jars, Concrete drum and Concrete jars of major containers, Small Bago jar, Spirit flower pot, Spirit bowl, Metal bucket, Plastic bucket, Paint bucket, Plastic bowl, Earthen pot, and small metal drum of minor containers and Tyre, Paint bucket Sprinkle water bucket, discarded Concrete jar, Big pure water bottle, discarded Bago jar of miscellaneous containers. Of this the highest percentage of *Aedes* larvae were found in plastic drum 36.11%, Metal drum 25.00% and Concrete jars 22.22% in major containers, 33.33% of Paint buckets and Plastic bucket(14.29%) in Minor containers and Car Tyre (64.29%) in Miscellaneous container. Although Zin May Htet (2018) revealed that in Pakokku Township, highest percentage of *Aedes* larvae were found 89.66% in Concrete jars in major containers, 39.32% of flower pots , 20.875 of small bago jars, 29.13% of earthen pots in minor containers and 86.87% of Earthen bowls in miscellaneous were found highest positivity in three container categories of water storage containers. Moe Kyaing (2017) observed that when compare the containers positivity of *Aedes* larvae in Sin Lan village and Anout Taw village of Pakokku Township, Magway Region, the highest number of big bago jars were positive with *Aedes* larvae in major containers followed by concrete tank, in minor containers, earthen pots were found highest larval positivity followed by flower pots. In the present study mostly spirit flower pots and spirit bowls were used in semi outdoor for worshipping flowers to Spirit and 81.69% of the major minor and miscellaneous containers were placed out door of the houses without cover. Same result has been found in Hpa-an Township Kayin State, because these water storage containers were placed forward and back ward of the house's under the gutters, without covers to keep water for household used and found big bago jars were highly positivity with *Aedes* larvae (Than Than Kyi, 2015, Maung Maung Mya et al., 2016). Although other researchers found that metal drums, bago jars, concrete jars and discarded car tires were highly larvae positive in Yangon areas. Because metal drums, bago jars and concrete jars which containers were placed under the gutters to keep rain water in raining season and lage number of discarded car tires were placed in outdoor of car workshops (Tun Lin et al., 1995, Pe Than Htun et al., 2010, Maung Maung Mya et al., 2011). Researchers revealed that metal drum and big Bago jars in major and earthen pot and small Bago jars, flower pots in minor and discarded earthen pot and car tier were found highly positive with *Aedes* larvae in Kyi Myint Tine Township, Shew Pyi Thar Township, and Thakayta Township (Tun Lin et al., 1995, Maung Maung Mya et al., 2011, 2013). Although Pe Than Htun et al., 2010) observed that concrete jars were found *Aedes* larvae were highly positive in dry season in Dala areas in Yangon region. Flower pots were found highly positive in Word No. 6. Same results has been observed in Hpa-an Township, high numbers of minor containers were inspected in Taung Nar village because the villagers used high number of flower vases in household for worshipping of religious purposes (Than Than Kyi, 2015). Although other researchers observed that in Yangon areas, mostly larvae were positive in spirit bowls, metal drums and concrete jars (Pe Than Htun et al., 2010, Maung Maung Mya et al., 2011). In the present study Plastic drums, Metal drums, Concrete jars, Paint bucket, Plastic bucket and Car tyres were found high number of *Aedes* larvae positivity.

A study by Surtees (1968) in Dar es Salaam found out that discarded tins were the most prolific source of *Ae. aegypti* larvae compared with other breeding habitats such as oil drums, leaf axils, old tyres and water storage containers. Similarly, Trpis (1972) identified tyres, tins, wrecked motor cars, water-pots, snail shells, coconut shells, and tree holes as the most common breeding sites of *Ae. aegypti* of which tyres were by far the most important and provided a constant source of *Ae. Aegypti*. The same author also found out that larvae of *Ae. aegypti* occurred in sympatry with larvae of *Ae. simpsoni*. These findings are in tandem with the observations made in the current study. Furthermore, Null (2005) in a survey of the mosquitoes breeding habitats found out that

Ae.aegypti mosquitoes were abundant in urban areas. This was further linked to availability of breeding habitats in urban environment. In addition, discarded automobile tyres were found to be ideal breeding sites in the USA (Chambers *et al.*, 1986) and in Puerto Rico (Moore *et al.*, 1978), whereas in Colombia large drums were the preferred breeding habitats (Nelson *et al.*, 1984). The breeding of *Ae.aegypti* in containers and around human habitation is no doubt one of the contributory factors towards its success.

In the present study found that the water storage containers from Key premises were place outside of the houses and Key containers were mostly found black coloured in open areas as well as without covered. Although other researchers mentioned that the water storage containers of Key premises houses were placed in the houses (Zin May Htet 2018) and key containers were mostly placed under the roof and full with rain water which were favourable for gravid female *Aedes aegypti* to lay their eggs in these containers (Maung Maung Mya et al., 2016). Most of the major containers, major breeding sources and key containers which were usually found under the roof gutters just outside the houses are usually replenished by rainfall (Tin Mar Yi Tun, 2007, Maung Maung Mya, 2013, Nan Than Than Kyi 2015).

In conclusion, females choose other strategies, spreading the higher proportion of their eggs and depositing some at the favourite breeding site. The highest percentage of *Aedes* larvae positivity was found in black and blue coloured containers were highly larvae positivity followed by white and concrete water storage containers (darkgreen), although yellow clear and steel water storage containers were found larvae negative. Of this viewing of the present study in Amuehtan Ward in Thanlyin Township, was found high larval positivity, high number of Key containers and Key premises as well as it is a very serious problem for DHF transmission in raining season in this area if it is not properly control.

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