

Male and Female Rosy Barb Fish (*Pethia conchonius*) Predation Time Against *Aedes aegypti* Mosquito Larva and Pupa Stage in the Morning

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ABSTRACT

Introduction: The control program for Dengue Hemorrhagic Fever (DHF) outbreaks prioritizes controlling the mosquito vector population. One way of biologically controlling mosquitoes that is safer and more environmentally friendly is fish as natural predators of larval and pupae stage mosquitoes. One fish tested in this study was Rosy Barb (*Pethia conchonius*). **Objective:** This study aimed to compare the male and female fish predation ability of rosy barb (*P. conchonius*) in *Aedes aegypti* larval and pupal stages. **Methods:** This study is a laboratory experiment with a post-test-only design and five replications. One aquarium holds one litre of water, one fish, and 25 *Ae. aegypti* larvae/pupa. The test begins at 09.00 WIB in the morning. The ended when fish finished consuming all larvae and pupae. **Results:** The mean time of predation of male *P. conchonius* to larvae was 12.03 minutes, and pupae were 2.83 minutes. The mean time of predation of female *P. conchonius* on larvae was 11.70 minutes, and pupae were 4.28 minutes. The results of the independent sample t-test showed that male and female fish had mosquito larvae feeding times that were not significantly different ($p > 0.05$). Male and female fish had mosquito pupa feeding times that were not significantly different ($p > 0.05$). **Conclusions:** Male and female Rosy barb fish have the same average feeding time for larvae and pupae.

Key words: *Aedes aegypti*, *Pethia conchonius*, Male fish, Female fish, Larvae, Pupae.

INTRODUCTION

The *Aedes* mosquito is a genus of mosquitoes important in Indonesia. The *Aedes* mosquito is a vector of arthropod-borne diseases for dengue virus, chikungunya, zika, yellow fever viruses, and filarial worm.^{1,2} According to the World Health Organization, dengue fever is the most salient mosquito-borne viral disease and public health importance in tropical and temperate regions of the world.³ The first dengue outbreak was reported in Surabaya and Jakarta, Indonesia, in 1968.⁴ Indonesia has two *Aedes* species: *Aedes aegypti* and *Aedes albopictus*.^{5,6}

The Indonesian Ministry of Health report said that dengue fever cases in 2021 were 73,518 cases. The DHF mortality rate in 2022 is 705 deaths.⁷ From these problems, it is necessary to control mosquito vectors to reduce the incidence of morbidity and mortality. The control program for Dengue Hemorrhagic Fever (DHF) outbreaks prioritizes controlling the mosquito vector population. Until now, controlling dengue fever has relied on reducing potential breeding sites at home and chemical control of *Aedes aegypti* larvae and adults.⁸ Organophosphate temephos is a commonly used larvicide for public health interventions. Chemical control of the *Aedes* mosquito has declined due to insecticide resistance and environmental consequences, such as vector resistance and toxicity to humans and non-target organisms.^{9,10} Using insecticides for mosquito control, including organophosphates, carbamates, and pyrethroids, can also adversely affect human health.¹¹ A previous

study by Haziqah-Rashid shows that all *Ae. aegypti* larvae from 10 study sites in Indonesia (Kuningan, Padang, Samarinda, Pontianak, Denpasar, Mataram, Dompu, Manggarai Barat, East Sumba, and South-Central Timor) resistant to diagnostic doses of temephos larvicide with mortality rates ranging from 0- 76%.⁴ Three sub-districts in Surabaya (Tambaksari, Gubeng and Sawahan) reported the mortality rate of *Ae. aegypti* larvae are below 80%, which indicates possible resistance to temephos.¹² Laos, Cambodia, Thailand, Vietnam, Brazil, Pakistan, and Peru have reported temephos-resistant *Aedes aegypti* larvae.¹³⁻¹⁵

Scientists continue exploring new methods to control mosquito populations from this problem. One of the alternative vector controls to overcome resistance to temephos using biological control.¹⁶ Living things that can be used as biological control are Bti granules, larvivorous fish, *Toxorhynchites* mosquito larvae, and larvivorous copepods.¹¹ One way of biologically controlling mosquitoes that is safer and more environmentally friendly is fish as natural predators of larval and pupae stage mosquitoes. These larvivorous fish were intentionally introduced to control mosquitos in the United States prior to the introduction of pesticides in 1921, but their use was greatly reduced after the widespread use of effective chemicals. Because of the development of resistance in mosquitos to chemical pesticides, the use of larvivorous fish to control mosquitos is being reconsidered.¹⁷ Many studies from various countries report that larvivorous fish have successfully controlled *Anopheles* larvae in a variety of habitats around the world.¹⁸ Some

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fish that have been recognized as larvivorous fish and applied in the community are *Gambusia affinis*, *Poecilia reticulata*, *Carassius auratus*, and *Aplocheilus lineolatus*.¹¹ One fish tested in this study was rosy barb (*Pethia conchonius*). Male *P. conchonius* fish has a distinctive characteristic: a coloured body orange and a belly slimmer, while the female fish is paler in colour and has a more rounded belly. This fish has a black colour at the tip of the dorsal fin and tail base. Rosy Barb fish are easy to find at the fish market and shop, with a cheap price of 3,000-4,000 rupiah.¹⁹ Previous studies reported rosy barb male sex has a faster predation ability against third-instar larvae of *Ae. aegypti* than other fish (female rosy barb, male and female lemon fish) in the evening (15.00 WIB).¹⁹

This study aimed to compare the male and female fish predation ability of rosy barb fish (*P. conchonius*) in *Aedes aegypti* larval and pupal stages in the morning.

MATERIALS AND METHODS

Ethical considerations

This research is an experimental study in a laboratory with a post-test-only design method. The Ethical Committee Medical Research Universitas Ciputra Surabaya, Indonesia, approved this study (No.140/EC/KEPK-FKUC/XII/2021).

Fish and mosquito preparation

Male and female rosy barb fish (*P. conchonius*) can be found at the Geluran-Taman fish shop in Sidoarjo. The fish tested had a length of 5-5.5 cm from the mouth to the tip of the tail fin. Fish determination is carried out in the Service Unit Identification at the University's Faculty of Marine Fisheries Airlangga. The mosquitoes tested were species of *Ae. aegypti* larval stage (third-instar larvae) and pupa stage. Larvae and pupae of *Ae. aegypti* obtained from the Entomology Laboratory, Institute of Disease Tropical, Universitas Airlangga Surabaya.

Fish predation testing

Before the study began, the fish were adjusted (acclimatization) first. This acclimatization begins by placing the fish in the aquarium for one week. Fish were fed fish pellets twice a day. One day before testing, the fish were not fed for one day. On the day of testing, one fish was included in one 14 cm (length) x 14 cm (width) x 24 cm (height) aquarium containing two litres of tap water. 25 larvae or 25 pupae of *Ae. aegypti* are put into an aquarium that already contains fish. After the mosquito larvae or pupae are poured into the aquarium, we record the time the fish eats the larvae or pupae until they run out.

Statistical analysis

Differences in feeding time of male and female fish to mosquito larvae and pupae will be analyzed using independent sample t-test, with the condition that the feeding time data has a normal distribution and homogeneous data variance. The normality test will be analyzed using Shapiro-Wilk, while the homogeneity test will be analyzed using the Levene test. The feeding time difference test will be analyzed using if the data is not normally distributed.

RESULTS

Rosy barb fish (*P. conchonius*) predation time to larvae and pupae of *Ae. aegypti*

The mean time of predation of male *P. conchonius* to larvae was 12.03 minutes, and pupae were 2.83 minutes. The mean time of predation of female *P. conchonius* on larvae was 11.70 minutes, and pupae were 4.28 minutes.

Feeding time for male and female fish against mosquito larvae

The results of the Shapiro-Wilk normality test when the data of (p = 0.176) and female (p = 0.050) fish on mosquito larvae were normally distributed (p > 0.05). At the same time, the results of Levene's homogeneity test showed that both had homogeneous data variance (p = 0.674). This means that both meet the requirements of using an independent sample t-test. The following are the results of the unpaired data t-test (independent sample t-test).

The average feeding time of male fish against larvae is 722.20 ± 874.75 seconds, with the fastest feeding time being 48 seconds and the longest feeding time being 2147 seconds. The female fish had a slightly faster average feeding time of larvae, namely 702.20 ± 957.55 seconds, with the fastest feeding time of 52 seconds and the longest feeding time of 2188 seconds. Both have a 20-second mealtime difference. The results of the independent sample t-test showed that male and female fish had larval feeding times that were not significantly different. (p = 0.973). This means that male and female fish have the same average feeding time for mosquito larvae [Table 1].

Feeding time for male and female fish against mosquito pupae

The results of the normality test of Shapiro Wilk when eating male (p = 0.164) and female (p = 0.392) fish against mosquito pupae had data that were normally distributed (p > 0.05). Meanwhile, Levene's homogeneity test results showed that both had homogeneous data variances (p = 0.476). This means that both meet the requirements of using an independent sample t-test. The following are the results of the unpaired data t-test (independent sample t-test).

Data from Table 2 showed the average feeding time of male fish against pupae is 169.80 ± 61.65 seconds, with the fastest feeding time being 112 seconds and the longest feeding time being 274 seconds. The female fish had a slightly longer average feeding time of pupae which was 257.20 ± 104.95 seconds, with the fastest feeding time of 147 seconds and the longest feeding time of 429 seconds. Both have a difference in feeding time of 87.4 seconds. The results of the independent sample t-test equal variance assumed statistical test showed that male and female fish had mosquito pupa feeding times that were not significantly different (p = 0.147 > 0.05). This means that male and female fish have the same average feeding time of mosquito pupae.

DISCUSSION

This study suspected that fish have a predation rate based on fish sex and time. Previous study reports found that female fish *Aplocheilus panchax* eats larvae faster (6 minutes 44 seconds) than male fish.²⁰ There is a significant difference between male and female *P. conchonius* group predation in the evening. On the other hand, there is no significant

Table 1: Average feeding time of male and female fish against larvae (second).

Groups	n	Min	Max	Mean ± SD	Difference p
Male fish	5	48	2147	722,20 ± 874,75	20 0,973
Female fish	5	52	2188	702,20 ± 957,55	

Independent sample t-test equal variance assumed

Table 2: Mean feeding time of male and female fish against pupae (second).

Groups	n	Min	Max	Mean ± SD	Difference p
Male fish	5	112	274	169,80 ± 61,65	87,4 0,147
Female fish	5	147	429	257,20 ± 104,95	

Independent sample t-test equal variance assumed

difference between the predation of male and female *L. caeruleus* fish groups against third-instar larvae of *Ae. aegypti* in the evening.¹⁹ Fish history has identified mosquito larvae as previous prey, likely influencing the speed of fish predation. Lighting, room temperature, and aquarium size are all potential factors that influence fish predation speed.²¹ Another study found that a fish of predator's effectiveness is determined by its weight and sex of fish. Both tilapia species, Wild and GIFT, consume more larvae in the morning than in the evening. The daily appetite rhythm of larvivor fish follows a pattern, with the first peak in the morning and the second peak in the afternoon/evening.²² *Rasbora daniconius* and *Colisa fasciata* consumed more larvae during the day than at night in all water volumes, according to another study. In contrast to *Pseudomugil signifer*, the only species that did not show a significant reduction in larval consumption during the night experiments.²³ The predation power of fish can also be affected by several factors that are difficult to control, such as survival in harsh environmental conditions.²⁴

The ability of larvivor fish to eat up mosquito larvae and pupae will reduce the potential for the mosquito life cycle to reach the adult stage (imago) and transmit the virus to healthy people. The ability of rosy barb fish in this study needs to be implemented in the community. Ghosh said that larval fish in natural habitats that feed on *Anopheles* larvae had been used successfully in malaria control.²⁵ Giving betta fish proved to be effective in reducing the number of larvae in Talok Village, Turen District.²⁶ The using of larvivor fish is not hazardous to plants, beneficial insects, or human health.²² In this study, the *P. conchonius* fish predation time was faster when preying on the pupal stage of *Ae. aegypti* than the larvae. Previous research found that the small and large larvae of *Cx. pipiens* consumed daily by *O. niloticus* were significantly taller than the pupae.²⁷ As part of the vector management strategy in the endemic region, periodic surveys and monitoring of fish biodiversity, demarcation of breeding sites, field level research study on the efficacy of larvivor fishes, and public awareness on the establishment of larvivor fishponds should be implemented.²⁸

Potential larvivor Poeciliidae, Cyprinidae, Cyprinodontidae, and Chichlidae are known and used. In 1905, *Gambusia affinis* was introduced from Texas to Hawaii. In the 1920s, Spain and Italy. In the 1920s, it expanded to 60 countries. In 1908, *Poecilia reticulata* (Guppy) was introduced from South America to British India.²⁹ Guppies have the potential to be an effective natural biological vector control for *Ae. aegypti*, *Ae. albopictus*, and *Cx. quinquefasciatus*.³⁰ For a fish to be used as a mosquito biocontrol agent, it must meet two basic criteria: First, it must have a high predation efficacy on mosquito larvae; second, it must be resistant to low oxygen concentrations while also being toxic metabolite tolerant.³¹ In future research, it is expected that the potential of rosy barb fish needs to be tested on other species of mosquito larvae. Larvivor fish for *Aedes aegypti* in the field are still rarely found.³² Larvivor fish data needs to be dug more profound so that scientific information on predatory fish data can be obtained and help the government tackle dengue disease. Larvivor fishes can play an important role in mosquito larvae control.³³ The effectiveness, pollution free, economically viable, and low cost of incorporating fish rearing into community-based health structures suggest that they should be considered as a vector control tool as long as the benefits outweigh any potential environmental concerns.^{34,35}

The limitations of this study are that we have not tested how many larvae and pupae can be consumed by fish until they are full, nor the predation patterns of fish in communities with larger water bodies.

CONCLUSIONS

Male and female fish have the same average feeding time ($p > 0.05$) for larvae and pupae mosquitoes. Rosy barb fish (*P. conchonius*) has the

potential as a natural predator of *Ae. aegypti* larval and pupal stages. The research results will help the government use rosy barb fish that are more targeted and effectively implemented in society.

SUMMARY

This study reports the rosy barb fish (*P. conchonius*) has the potential as a natural predator of *Ae. aegypti* larval and pupal stages.

CONFLICTS OF INTEREST

All authors declare no conflicts of interest.

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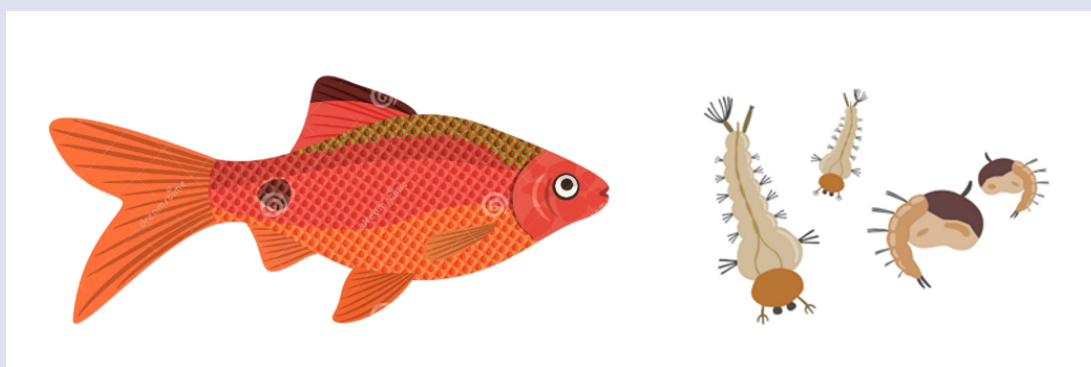
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REFERENCES

- Pereira BB, Caixeta ES, Freitas PC, Santos VSV, Limongi JE, de Campos Júnior EO, et al. Toxicological assessment of spinosad: implications for integrated control of *Aedes aegypti* using larvicides and larvivor fish. *J Toxicol Environ Heal*. 2016;79(12):477-81.
- Azevedo-Santos VM, Vitule JRS, Pelicice FM, Garcia-Berthou E, Simberloff D. Nonnative fish to control *Aedes* mosquitoes: a controversial, harmful tool. *Bioscience*. 2017;67(1):84-90.
- Mukhtar MM, Ibrahim SS. Temporal evaluation of insecticide resistance in populations of the major arboviral vector *Aedes aegypti* from Northern Nigeria. *Insects*. 2022;13(2):1-18.
- Haziqah-Rashid A, Chen CD, Lau KW, Low VL, Sofian-Azirun M, Suana IW, et al. Monitoring insecticide resistance profiles of *Aedes aegypti* (diptera: culicidae) in the Sunda islands of Indonesia based on diagnostic doses of larvicides. *J Med Entomol*. 2019;56(2):514-8.
- Garjito TA, Widiarti W, Hidajat MC, Handayani SW, Mujiyono M, Prihatin MT, et al. Homogeneity and possible replacement of populations of the fengue vectors *Aedes aegypti* and *Aedes albopictus* in Indonesia. *Front Cell Infect Microbiol*. 2021;11(2):1-12.
- Mulyatno KC, Kotaki T, Yotopranoto S, Rohmah EA, Churotin S, Sucipto TH, et al. Detection and serotyping of dengue viruses in *Aedes aegypti* and *Aedes albopictus* (diptera: culicidae) collected in Surabaya, Indonesia from 2008 to 2015. *Jpn J Infect Dis*. 2018;71(1):58-61.
- Ministry of Health of the Republic of Indonesia. Indonesia Health Profile. 2020;2020:215-9.
- Gan SJ, Leong YQ, bin Barhanuddin MFH, Wong ST, Wong SF, Mak JW, et al. Dengue fever and insecticide resistance in *Aedes* mosquitoes in Southeast Asia: a review. *Parasit Vectors*. 2021;14(1):1-19.
- de Góes Cavalcanti LP, Soares PRJ, Ferreira RAC, de Paula FJ, Frutuoso RL, Sousa EP, et al. Efficacy of fish as predators of *Aedes aegypti* larvae, under laboratory conditions. *Rev Saude Publica*. 2007;41(4):638-44.
- Mituassu LMP, Serdeiro MT, Vieira RRBT, Oliveira LS, Maleck M. *Momordica charantia* L. extracts against *Aedes aegypti* larvae. *Brazilian J Biol*. 2022;82:1-6.
- Benelli G, Jeffries CL, Walker T. Biological control of mosquito vectors: Past, present, and future. *Insects*. 2016;7(4):1-18.
- Mulyatno KC, Yamanaka A, Ngadino, Konishi E. Resistance of *Aedes aegypti* (L.) larvae to temephos in Surabaya, Indonesia. *Southeast Asian J Trop Med Public Health*. 2012;43(1):29-33.
- Marcombe S, Chonephetsarath S, Thammavong P, Brey PT. Alternative insecticides for larval control of the dengue vector

- Aedes aegypti* in Lao PDR: Insecticide resistance and semi-field trial study. *Parasit Vectors*. 2018;11(1):1-8.
14. Palomino M, Pinto J, Yañez P, Cornelio A, Dias L, Amorim Q, et al. First national-scale evaluation of temephos resistance in *Aedes aegypti* in Peru. *Parasit Vectors*. 2022;15(1):1-13.
 15. Khan HAA, Akram W. Resistance status to deltamethrin, permethrin, and temephos along with preliminary resistance mechanism in *Aedes aegypti* (diptera: culicidae) from Punjab, Pakistan. *J Med Entomol*. 2019;56(5):1304-11.
 16. Shafique M, Lopes S, Doum D, Keo V, Sokha L, Sam B, et al. Implementation of guppy fish (*Poecilia reticulata*), and a novel larvicide (pyriproxyfen) product (sumilarv 2MR) for dengue control in Cambodia: a qualitative study of acceptability, sustainability and community engagement. *PLoS Negl Trop Dis*. 2019;13(11):1-22.
 17. Chaudhry A. Mosquito control methods and their limitations. *Pure Appl Biol*. 2019;8(4):2389-98.
 18. Couret J, Notarangelo M, Veera S, Leclaire-Conway N, Ginsberg HS, Lebrun RL. Biological control of *Aedes* mosquito larvae with carnivorous aquatic plant, *Utricularia macrorhiza*. *Parasit Vectors*. 2020;13(2018):1-11.
 19. Adrianto H, Rambung E, Christiani N. Potential of male and female barbir (*Pethia conchonius*) and lemon (*Labidochromis caeruleus*) as biological predators of *Aedes aegypti* mosquito larvae. *J Kesehat Andalas*. 2022;11(1):50-4.
 20. Lukas JL, Adrianto H, Darmanto AG. Predation ability of male and female tinhead *Aplocheilichthys panchax* against *Aedes aegypti* mosquito larvae. *J Kesehat Andalas*. 2021;9(4):387-91.
 21. Andriani NDA, Adrianto H, Darmanto AG. Predation power of lemon fish (*Labidochromis caeruleus*) and capiat fish (*Barbonymus schwanenfeldii*) against *Aedes aegypti* mosquito larvae. *Aspirator - J Vector-borne Dis Stud*. 2021;13(1):37-46.
 22. Bibi S, Qayyum M, Naseem A, Khan D, Ali S, Sami-ur-rehman M, et al. Evaluation of wild tilapia and gift tilapia as biological control against mosquito larvae (*Culex quinquefasciatus* and *Aedes aegypti*) Shaheen. *Int J Mosq Res*. 2017;4(1):23-7.
 23. Oo NN, Thone MT, Ko MMM, Mya MM. Biological control of *Aedes* larvae using indigenous fish (*Rasbora daniconius* (Nga Dawn Zin) and *Colisa fasciata* (Nga Thit Kyauk)) from Pakokku Township, Magwe Region. *J Biol Eng Res Rev*. 2018;5(1):1-8.
 24. Ranathunge T, Kusumawathie PHD, Abeyewickreme W, Udayanga L, Fernando T, Hapugoda M. Biocontrol potential of six locally available fish species as predators of *Aedes aegypti* in Sri Lanka. *Biol Control*. 2021;160(2021):1-10.
 25. Ghosh SK, Chakaravarthy P, Panch SR, Krishnappa P, Tiwari S, Ojha VP, et al. Comparative efficacy of two poeciliid fish in indoor cement tanks against chikungunya vector *Aedes aegypti* in villages in Karnataka, India. *BMC Public Health*. 2011;11:1-8.
 26. Pangesti MD, Wahyudi Y, Susila WDC. Effectiveness of giving betta fish (*Betta splendens*) to reduce the number of larvae as a DHF prevention effort in Talok Village, Turen district. *Heal Care Media*. 2021;5(2):77-87.
 27. Mohamed IA, Fathy M, Farghal AIA, Temerak SAH, Sayed AEDH. Efficacy of Nile tilapia (*Oreochromis niloticus*) juveniles and spinosyns bioinsecticides against aquatic stages of *Culex pipiens*: an experimental study. *J Asia Pac Entomol*. 2021;24(1):190-4.
 28. Das MK, Rajesh KRM, Kulsreshtha AK. Native larvivorous fish diversity as a biological control agent against mosquito larvae in an endemic malarious region of Ranchi district in Jharkhand, India. *J Vector Borne Dis*. 2018;55(1):34-41.
 29. Vatandoost H. Use of larvivorous fishes for control of aquatic stage of mosquitoes, the vectors of diseases. *Int J Zool Anim Biol*. 2021;4(5):1-5.
 30. Satoto TBT, Sukendra DM, Hardaningsih I, Diptyanusa A. The influence of digestive tract length of larvivorous fish related to predation potential on *Aedes aegypti* larvae. *Unnes J Public Heal*. 2019;8(2):139-44.
 31. Datta A, Sen R, Banerjee R, Banerjee PK. Larvicidal efficacy of ornamental fishes to control *Aedes aegypti* in West Bengal. *Int J Mosq Res*. 2022;9(4):39-46.
 32. Sari M, Novela V. Biological control with the predating power of various fish larvae of *Aedes aegypti* in the working area of Tigo Baleh Puskesmas. *Indep Heal J*. 2020;15(1):79-85.
 33. Jafari A, Enayati A, Jafari F, Motevalli HF, Hosseini-Vasoukolaei N, Sadeghnezhad R, et al. A narrative review of the control of mosquitoes by larvivorous fish in Iran and the world. *Iran J Heal Sci*. 2019;7(2):49-60.
 34. Sangeetha S, Devahita AA, Arathilal, Aiswarya T, Parvin MS, Smitha M, et al. Comparative efficiency of Larvivorous fishes against *Culex* mosquitoes: Implications for biological control. *Int J Mosq Res*. 2021;8(3):16-21.
 35. Hustedt JC, Doum D, Keo V, Ly S, Sam BL, Chan V, et al. Field efficacy of larvivorous fish and pyriproxyfen combined with community engagement on dengue vectors in Cambodia: A randomized controlled trial. *Am J Trop Med Hyg*. 2021;105(5):1265-76.

GRAPHICAL ABSTRACT



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