

e-ISSN: 2620-8636

BIOMOLECULAR *and health* SCIENCE JOURNAL



Volume 3, Number 1, June 2020

**Published by:
Faculty of Medicine, Universitas Airlangga**

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Volume 3 No.1 2020

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TABLE OF CONTENT

ORIGINAL ARTICLE

- Effect of Pneumatic Balloon Dilation to The Changes of Eckardt Score in Patient With Achalasia** 1-4
Budi Widodo, Iswan Abbas Nusi, Titong Sugihartono
- Pattern of Perioperative Antibiotic Use in Otorhinolaryngology-Head and Neck Surgery at Third Referral Hospital In Surabaya** 5-10
Nabilah Puspa Utami, Dyah Fauziah, Muhtarum Yusuf
- Combination of Red Coconut Coir (*Cocos nucifera L. var rubescens*) and Linezolid on Methicillin-Resistant *Staphylococcus aureus* in vitro Growth** 11-14
Trisnawati Trisnawati, Wiwin Retnowati, Danti Nur Indiasuti
- Correlation between Allergic Rhinitis and Rhinosinusitis in ENT Outpatient Clinic Patients** 15-18
Felicia Alvita Tjahjono, Irwan Kristyono, Ari Baskoro
- Hypoglycemic and Antioxidant Activity of *Petiveria alliacea* in Diabetic Rat Models** 19-23
Vania Azalia Gunawan, Harlina Soetjipto, Arifa Mustika
- Antibacterial Activity Test of Red Ginger Extract (*Zingiber officinale var. Rubrum*) Against *Streptococcus pyogenes* In vitro** 24-27
Samira Assegaf, Arthur Pohan Kawilarang, Retno Handajani
- Pre-Operative Enhanced Recovery After Surgery (ERAS) Protocol Compliance Towards Major Surgery Patients at Dr. Soetomo General Hospital, Surabaya** 28-32
Ahmad Sabili Rifa'i, Gadis Meinar Sari, Vicky Sumarki Budipramana
- Characteristics and Histopathological Grading of Malignant Spiculated Mass in regards to Histopathological Grading of Breast Cancer Based on The Nottingham Grading System** 33-36
Andi Syarti, Ulinta Pasaribu, Dyah Fauziah, Lies Mardiyana, Tri Wulanhandarini
- Prevalence of Benign Vocal Fold Lesions in Ear, Nose, and Throat Outpatient Unit of Dr. Soetomo General Hospital, Surabaya, Indonesia** 37-40
Lucia Miranti Hardianingwati, Diar Mia Ardani
- Fauna of *Culex* Mosquitoes In Salamwates Village Dongko Subdistrict, Trenggalek City** 41-44
Mardliyana Shalihah, Budi Utomo, Subagyo Yotopranoto, Heny Arwati

Does Mental Health Literacy Influence Help-Seeking Behavior in Medical Students? 45-48

Nandini Amithya Pramesi Lumaksono, Pudji Lestari, Azimatul Karimah

CASE REPORT

The Unusual Presentation of Acute Pericarditis Mimicking Acute Coronary Syndrome 49-52

Nenci Siagian, Muhammad Vitanata Arfijanto

Challenging Therapy In Pregnant Woman With Systemic Lupus Erythematosus (SLE) and Chronic Hepatitis B 53-55

Choirina Windradi, Awalia Awalia

REVIEW ARTICLE

Current Update on the Risk Factor Modification and Exercise Following Coronary Artery Disease 56-61

Nia Dyah Rahmianti, Teuku Yusrizal, Makhyan Jibril Al-Farabi

ORIGINAL ARTICLE

Culex Mosquitoes Fauna In Salamwates Village, Trenggalek City, East Java

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ARTICLE INFO

Article history:

Received 12 May 2020

Received in revised form 28 May 2020

Accepted 02 June 2020

Available online 30 June 2020

Keywords:

Mosquito-borne diseases,
Nocturnal mosquito,
Zoophilic,
Culex tritaeniorhynchus.

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ABSTRACT

Introduction: Mosquito-borne diseases are still a burden worldwide, including in Indonesia. Some of those diseases, such as filariasis and Japanese encephalitis, are transmitted by some species of *Culex* mosquitoes. We aimed to describe the fauna of *Culex* mosquitoes in Salamwates village, Dongko subdistrict, Trenggalek district.

Methods: Female *Culex* mosquitoes were collected in Salamwates village at night using the methods of indoor human-baited double bed-net trap and outdoor cow-baited double bed-net trap. The species of collected *Culex* mosquitoes were identified based on identification guide published by Ministry of Health of Republic Indonesia.

Results: There were 67 identifiable female mosquitoes collected using cow-baited methods and no female mosquitoes collected using human-baited methods. Those mosquitoes consisted of nine species. *Culex tritaeniorhynchus* (29.85%), *C. gelidus* (23.88%), *C. vishnui* (13.43%), *C. pseudovishnui* (11.94%) were the dominant species. The peaks of biting activities were at 18.45-19.00 and 23.45-24.00.

Conclusion: Nine species of *Culex* mosquitoes collected using cow-baited methods. *C. tritaeniorhynchus* was the dominant species. Those mosquitoes were zoophilic and exophagic. The peaks of biting activities of the *Culex* mosquitoes were at dusk and midnight.

Introduction

Vector-borne disease reached more than 17% of all infectious diseases in the world, with mosquitoes as the most common vector.¹ Mosquito-borne diseases are still a burden worldwide. Hundred species of mosquitoes have been known as disease carriers.² Those diseases have high morbidity and mortality rate and may cause an outbreak in Indonesia, including filariasis and Japanese encephalitis (JE) which are mainly transmitted by *Culex* mosquitoes that bite at night.^{3,4,5} *C. fuscocephala*, *C. tritaeniorhynchus*, *C. gelidus* and *C. vishnui* transmit the Japanese encephalitis virus in the Oriental region.^{4,5,6} *C. quinquefasciatus* is known as an important vector of bancroftian filariasis and found widespread across continents.^{7,8} Most of these species mainly bite cattle and pigs and humans and their breeding places include rice paddies, swamps and water with high levels of organic material.^{7,9}

JE transmission in Indonesia was said to be likely increase because of large agricultural areas, population

growth, pig rearing, and lack of surveillance and vaccination program.¹⁰ Transmission of JE in the tropics occurs year-round and increases in the rainy season.¹¹ The incidence of JE is 1.8 per 100,000 and about 20-30% cases are fatal and 30-50% of patients have significant neurological sequelae.⁹ Indonesia is also an area with a high risk of filariasis transmission. There were 31 provinces and 337 districts/cities endemic for filariasis with a total of 11,914 chronic cases until 2009. Filariasis can cause disability and psychosocial stigma that has impact on the reducing patient productivity, family burdens and huge economic losses for the country if not handled properly.¹² Trenggalek is one of the districts that was still burdened by diseases transmitted by mosquitoes. There are still new cases of filariasis in Trenggalek district in the last decade, with increasing number of cases year by year.^{13,14,15}

Problems of vector control encountered in Indonesia are inadequate data of vector species and mapping of the vectors distribution in endemic areas, the increase



of resistant population of multiple vectors to specific pesticides, and the limited resources of both personnel, logistical and operational costs. Mosquitoes have different characteristics of biting activity. Mosquitoes can bite during the day (diurnal) or at night (nocturnal). Mosquitoes are called endophagic if they bite indoor and called exophagic if they bite outdoor. Anthropophilic refers to the mosquito that prefers human blood while zoophilic refers to mosquito that prefers to bite of animals.¹⁶

There are still no sufficient data about *Culex* mosquitoes in Trenggalek district that are vectors potential of diseases such as filariasis and JE. Therefore, this study is aimed to describe the fauna of *Culex* mosquitoes in Salamwates village Trenggalek district, including the species and the biting behavior.

Methods

This study is a descriptive study by the identification of the collected sample. *Culex* mosquito samples were collected in Krajan, Salamwates Village, Dongko Subdistrict, Trenggalek. *Culex* mosquitoes were collected at night using the method of indoor human-baited double bed-net trap and outdoor cow-baited double bed-net trap between 18.00 - 24.00.

Mosquito collection were done in six periods by using double bed-net,^{17,18} called inner net and outer net with a 75cm gap. Human-baited methods were using 2m x 2m x 2m nets and done every hour within a period of 45 minutes. Cow-baited methods were using 6m x 6m x 2m nets and done every hour within a period of 15 minutes each after human-baited method. The mosquitoes trapped between the two nets were collected using an aspirator and a flashlight.

Collected mosquitoes were put in a plastic cup sealed with gauze based on collection periods and methods. The cup were labeled with date, time, location, indoors or outdoors, and method of collection. All collected

mosquitoes were then stored by cold preservation using refrigerator¹⁹ and to be identified later. *Culex* spp. mosquitoes were identified in the Laboratory of Parasitology, Faculty of Medicine, Universitas Airlangga based on identification guide published by Ministry of Health of Republic Indonesia.²⁰ Female *Culex* mosquitoes accorded with the identification guide published were included while mosquitoes with some parts of the body were incomplete and could not be identified were excluded.

Obtained data consisted of species composition, time distribution, and biting behavior of *Culex* mosquitoes. The data were presented in tables and graphs and analyzed. Descriptive data analysis included counting the number and proportion.

Results

Two male mosquitoes and no female mosquitoes were collected using human-baited methods. 87 mosquitoes, consisting of 67 identifiable female mosquitoes, 18 male mosquitoes, and two unidentifiable female mosquitoes, were collected using cow-baited methods.

Table 1 shows that mosquitoes collected by cow-baited methods consisted of nine species. *C. tritaeniorhynchus* was the dominant species (29.85%), followed by *C. gelidus* (23.88%), *C. vishnui* (13.43%), *C. pseudovishnui* (11.94%), *C. fuscocephalus* (7.46%), *C. sitiens* (5.97%), *C. quinquefasciatus* (4.48%), *C. sinensis* (1.49%), and *C. pseudosinensis* (1.49%). The peaks of biting activities were at 18.45-19.00 and 23.45-24.00. The biting activities of each species of *Culex* were different. *C. tritaeniorhynchus*, *C. vishnui*, *C. pseudovishnui*, and *C. quinquefasciatus* had higher activities at dusk and midnight. The peaks of *C. tritaeniorhynchus*' biting activities were at 18.45-19.00 and 23.45-24.00, 7 and 9 mosquitoes consecutively. *C. gelidus* had its highest biting activities at 19.45-20.00.

Table 1. Number of female *Culex* mosquitoes collected by cow-baited methods.

Species	Period of mosquito collection						Total	Percentage (%)
	1 18.45-19.00	2 19.45-20.00	3 20.45-21.00	4 21.45-22.00	5 22.45-23.00	6 23.45-24.00		
<i>C. tritaeniorhynchus</i>	7	1	0	1	2	9	20	29.85
<i>C. gelidus</i>	0	9	6	1	0	0	16	23.88
<i>C. vishnui</i>	3	0	0	2	4	0	9	13.43
<i>C. pseudovishnui</i>	3	0	0	0	1	4	8	11.94
<i>C. fuscocephalus</i>	0	0	1	1	1	2	5	7.46
<i>C. sitiens</i>	2	0	0	1	0	1	4	5.97
<i>C. quinquefasciatus</i>	1	0	0	0	1	1	3	4.48
<i>C. sinensis</i>	1	0	0	0	0	0	1	1.49
<i>C. pseudosinensis</i>	0	0	1	0	0	0	1	1.49
Total	17	10	8	6	9	17	67	100

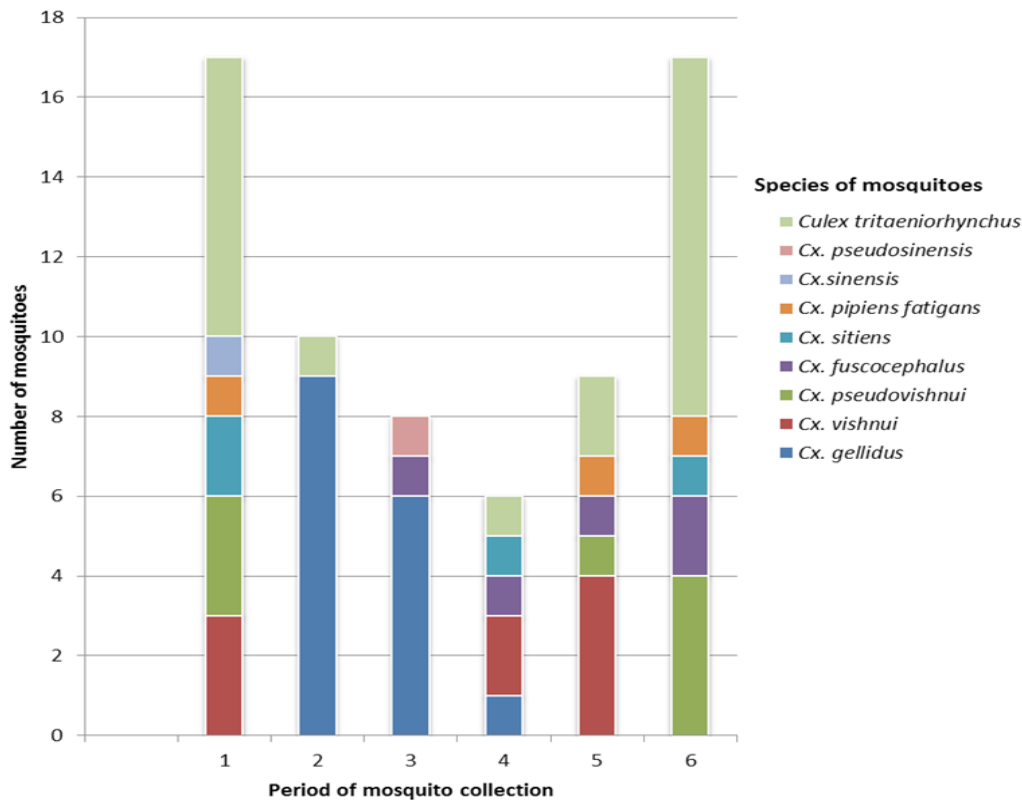


Figure 1. Biting activities period of each *Culex* species

Discussion

C. tritaeniorhynchus alongside with *C. quinquefasciatus* were the dominant species collected in this study. There were many breeding places of those mosquitoes found in Salamwates, where the mosquitoes were collected, including rice paddies, ponds, and sewerage. Agriculture and cattle farming were the main livelihoods in the area. *C. tritaeniorhynchus* is the primary vector of JE in the oriental region and mainly bite cattle and pigs.^{21,22} *C. tritaeniorhynchus* mainly bite outdoors and will bite human when cattle and pigs were unrepresented.^{5,21} Das et al. (2004),²³ found that *C. tritaeniorhynchus* was also the predominant species collected outdoor. *C. gelidus* is zoophilic species which particularly bite animals and can bite humans.²⁴ *C. quinquefasciatus* was only 4.48% of the mosquitoes collected in this study. This species rarely bite humans inside the house and show zoophilic behavior both to mammals and birds.⁷ *C. quinquefasciatus* in the research by Wilson and Sevarkodiyone in India show the same preference to bite both humans and animals. Female mosquitoes were only collected in cow-baited methods in this study, therefore the human biting behavior of *Culex* mosquitoes could not be described.²⁵

This research does not investigate the presence of viruses or nematodes in the body of the mosquito but some of the species collected in this study have been known as vectors of JE and filariasis. WHO reported that filariasis vectors in Asia region included *C. quinquefasciatus* and *C. sitiens*.⁷ *C. quinquefasciatus* is stated as an important vector of *Wuchereria bancrofti* in the many countries,⁸ while *C. sitiens* contributes in *Brugia malayi* transmission.²⁶ *C. tritaeniorhynchus*, *C. gelidus*, *C. fuscocephalus*, *C.*

vishnui, *C. sitiens*, and *C. pseudovishnui* are vectors of JE. *C. fuscocephala*, *C. gelidus*, and *C. tritaeniorhynchus* were also found as the major species of mosquitoes in Bali,^{27,28} in which annual incident rate of JE is 7,1 per 100,000 children under 10 year old.²⁹ The disease is predominantly found in area where humans live in closer proximity to pigs as the hosts.³⁰ *C. quinquefasciatus* was dominant species alongside with *C. tritaeniorhynchus* and *C. pseudovishnui*.³¹ Surabaya had filariasis cases from Health Office of East Java Province and those species mosquitoes are infectious disease vectors.¹³

Mosquito biting periods affect the rhythm of disease transmission.³² This study showed that the number of mosquitoes most obtained in the initial period of collection in the evening then declined until the mid-period of collection and increased again as midnight approached. Rogozi et al. (2012),³³ in their research with human bait concluded that *Culex* had three peaks of activity at night that is in the early evening, in the middle of the night and in the early morning. The mosquitoes caught in this study had diverse distribution based on collection periods. *C. tritaeniorhynchus* had the peak activity in the early evening and mid-night. These results are similar to studies in Malaysia,³⁴ but contrast to the results of research in South India,²² which obtained that the peak of *C. tritaeniorhynchus* activity occurred at 21.00. *C. pseudovishnui*, *C. vishnui*, and *C. quinquefasciatus* had the same pattern of activity as *C. tritaeniorhynchus*. These results agreed with the results of other studies in Philippines,³⁵ in Kuala Lumpur,⁵ and in South India.²² The biting activity and frequency of mosquitoes depend on the mosquito species, environment conditions, ecological conditions and requirements from the gonotrophic cycle of

mosquitoes.³³ The biting rhythm of mosquitos can also be influenced by co-existence and sharing of hosts available in rural areas to avoid competitions between themselves.²²

This study has some limitations. Mosquitos were only collected indoor with human-bite collection. We also only collected the data from 18.45 to 24.00. We could not present the data of outdoor mosquito activities in biting human and the mosquito activities from midnight to dawn. Human outdoor activities at night increases the chances of contact with mosquitoes, especially during the peak of mosquito activity.¹¹ There are many factors that affect the risk of mosquito-borne disease transmission, such as the age of mosquitoes, mosquito density and its contact with humans, resistance to parasites, and the source of infection. Health education and entomological surveillance are required and should be followed up with a program to control the spread of disease vectors and with an evaluation to assess the effectiveness of the vector-controlling program.

Conclusion

Culex mosquitoes collected using cow-baited methods consisted of nine species, namely *C. tritaeniorhynchus*, *C. gelidus*, *C. vishnui*, *C. pseudovishnui*, *C. fuscocephalus*, *C. sitiens*, *C. quinquefasciatus*, *C. sinensis*, and *C. pseudosinensis*. *C. tritaeniorhynchus* was the dominant species. Those mosquitoes were zoophilic and exophagic. The peaks of biting activities were at 18.45-19.00 and 23.45-24.00.

Further research about *Culex* mosquitoes should cover wider range of samples, include mosquitoes collection in day and night time with longer duration in several seasons.

Conflict of Interest

The author stated there is no conflict of interest

References

1. WHO. Vector-borne disease, <http://www.who.int/mediacentre/factsheets/fs387/en/> (2014).
2. Harbach RE. The Culicidae (Diptera): a review of taxonomy, classification and phylogeny. *Zootaxa* 2007; 1668: 591–638.
3. Kementerian Kesehatan Republik Indonesia. Peraturan Menteri Kesehatan Republik Indonesia nomor: 374/Menkes/Per/III/2010 tentang pengendalian vektor.
4. Lindahl J, Chirico J, Thu HTV, et al. Occurrence of Japanese encephalitis virus mosquito vectors in relation to urban pig holdings. *Am J Trop Med Hyg* 2012; 87: 1076–1082.
5. Chen CD, Lee HL, Lau KW, et al. Biting behavior of Malaysian mosquitoes, *Aedes albopictus* Skuse, *Armigeres kesseli* Ramalingam, *Culex quinquefasciatus* Say, and *Culex vishnui* Theobald obtained from urban residential areas in Kuala Lumpur. *Asian Biomed* 2014; 8: 315–321.
6. Okuno T, Mitchell CJ, Chen PS, et al. Experimental transmission of Japanese encephalitis virus by *Culex tritaeniorhynchus* and *C. fuscocephalus*. *Ann Trop Med Parasitol* 1975; 69: 203–206.
7. World Health Organization. Lymphatic filariasis: a handbook of practical entomology for national lymphatic filariasis elimination programmes. World Health Organization, 2013.
8. The Walter Reed Biosystematics Unit. *Culex* (*Cux.*) *quinquefasciatus*. The Walter Reed Biosystematics Unit, http://www.wrbu.org/mqID/mq_medspc/AD/CXqui_hab.html (2016).
9. Campbell GL, Hills SL, Fischer M, et al. Estimated global incidence of Japanese encephalitis: a systematic review. *Bull World Health Organ* 2011; 89: 766–774.
10. Erlanger TE, Weiss S, Keiser J, et al. Past, present, and future of Japanese encephalitis. *J Emerg Infect Dis* 2009; 15: 1–7.
11. Center for Disease Control and Prevention. Japanese encephalitis, <http://www.cdc.gov/japaneseencephalitis/> (2019).
12. Departemen Kesehatan RI. Rencana Nasional Program Akselerasi Eliminasi Filariasis di Indonesia. Jakarta: Direktorat P2B2. Direktorat Jendral PP&PL. Depkes RI, 2010.
13. Dinas Kesehatan Provinsi Jawa Timur. Profil kesehatan provinsi Jawa Timur tahun 2012. Surabaya: Dinas Kesehatan Provinsi Jawa Timur, 2013.
14. Dinas Kesehatan Kabupaten Trenggalek. Profil kesehatan kabupaten Trenggalek tahun 2013. Trenggalek: Dinas Kesehatan Kabupaten Trenggalek, 2014.
15. Dinas Kesehatan Kabupaten Trenggalek. Profil kesehatan kabupaten Trenggalek tahun 2015. Trenggalek: Dinas Kesehatan Kabupaten Trenggalek, 2016.
16. Direktorat Jenderal Pemberantasan Penyakit Menular dan Penyehatan Lingkungan (Ditjen PPM dan PL). Pedoman ekologi dan aspek perilaku vektor. Jakarta: Departemen Kesehatan, 2004.
17. Service MW. A critical review of procedures for sampling populations of adult mosquitoes. *Bull Entomol Res* 1977; 67: 343–382.
18. Tangena JA, Thammavong P, Hiscox A, et al. The Human-Baited Double Net Trap: An Alternative to Human Landing Catches for Collecting Outdoor Biting Mosquitoes in Lao PDR. *PLoS One* 2015; 10: e0138735.
19. Dowell FE, Noutcha AE, Michel K. Short report: The effect of preservation methods on predicting mosquito age by near infrared spectroscopy. *Am J Trop Med Hyg* 2011; 85: 1093–1096.
20. Departemen Kesehatan RI. Kunci Identifikasi *Culex* jentik dan Dewasa di Jawa. Jakarta: Ditjen P2M. PLP. Depkes RI, 1989.
21. The Walter Reed Biosystematics Unit. *Culex* (*Cux.*) *tritaeniorhynchus*. The Walter Reed Biosystematics Unit, http://www.wrbu.org/mqID/mq_medspc/AD/CXtri_hab.html (2016).
22. Paramasivan R, Philip SP, Selvaraj PR. Biting rhythm of vector mosquitoes in a rural ecosystem of south India. *Int J Mosq Res* 2015; 2: 106–113.
23. Das BP, Lal S, Saxena VK. Outdoor resting preference of *Culex tritaeniorhynchus*, the vector of Japanese encephalitis in Warangal and Karim Nagar districts, Andhra Pradesh. *J Vector Borne Dis* 2004; 4: 32–26.
24. The Walter Reed Biosystematics Unit. *Culex* (*Cux.*) *gelidus*. The Walter Reed Biosystematics Unit, http://www.wrbu.org/mqID/mq_medspc/AD/CXgel_hab.html (2016).
25. Wilson JJ, Sevarkodiyone SP. Behavioral expression (breeding and feeding) of mosquitoes in an agro ecosystem. (Athikulam, Virudhunagar District Tamil Nadu, India). *Eur J Biol Sci* 2013; 5: 99–103.
26. New Zealand Biosecure Entomology Laboratory. *Culex* (*Culex sitiens*) Wiedemann.
27. Adi AAAM, Astawa NM, Damayanti PAA, et al. Seroepidemiological evidence for the presence of Japanese encephalitis virus infection in ducks, chickens, and pigs, Bali-Indonesia. *Bali Med J* 2016; 5: 189–193.
28. Lee VH, Atmosoedjono S, Rusmiarto S, et al. Mosquitoes of Bali island, Indonesia: common species in the village environment. *Southeast Asian J Trop Med Public Health* 1983; 14: 298–307.
29. Kari K, Liu W, Gautama K, et al. A hospital-based surveillance for Japanese encephalitis in Bali, Indonesia. *BMC Med* 2006; 4: 8.
30. WHO. Japanese encephalitis, <http://www.who.int/mediacentre/factsheets/fs386/en/> (2014).
31. Yotopranoto S, Bendryman SS, Rosmanida. Fauna nyamuk yang berpotensi sebagai vektor penyakit infeksius di kota Surabaya. *Maj Kedokt Trop Indones* 2008; 19: 37–47.
32. Gandahasada S, Ilahude HD, Pribadi W. Parasitologi kedokteran. Jakarta: Balai Penerbit Universitas Indonesia, 1998.
33. Rogozi E, Ahmad RB, Ismail Z. Biting activity cycles of some antropophilic mosquito species in Malaysia. *J Int Environ Appl Sci* 2012; 7: 894–900.
34. Rohani A, Zamree I, Ali WNW, et al. Nocturnal man biting habits of mosquito species in Serian, Sarawak, Malaysia. *Adv Entomol* 2013; 1: 42–49.
35. Schultz GW, Hayes CG. Ecology Of mosquitos (Diptera: Culicidae) at a site Republic of the Philippines. *Southeast Asian J Trop Med Public Health* 1993; 24: 157–164.