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The study of fauna and vectorial competency of mosquito (Diptera:Culicidae) at Satu'un Village, Muara Uya Subdistrict, Tabalong District, South Kalimantan Province

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ABSTRACT

In Indonesia, mosquito-transmitted diseases such as malaria, dengue haemorrhagic fever (DHF), and filariasis, still become main public health problems. Mosquito species which usually act as disease vector are *Aedes sp, Culex sp, Anopheles sp* and *Mansonia sp.* The aim of this study was to comprehend the mosquito fauna, bionomical and vector competence of *Aedes sp, Culex sp, Anopheles sp* and *Mansonia sp* at Santu'un Village, Muara Uya Subdistrict, Tabalong District, South Kalimantan Province. Man Biting method using aspirator was used to capture mosquitoes. Mosquito dissection, ELISA and immunohistochemistry were performed to find microfilaria larvae, sporozoit Sp. of Plasmodium and dengue virus, respectively. The results showed that *Cx.quinquefaciatus, Cx.tritaeniorhyncus, Cx pipiens* and *Cx.gelidus* were exophagic. *Culex quinquefaciatus* and *Cx.tritaeniorhyncus* biting activity was began at 7 – 8 pm with their biting rate were 102.5 and 44.5 mosquitoes/person/night, respectively. *Anopheles umbrosus* was endophagic. Its biting activity peaked at 8 – 9 pm with its biting rate was 0.5 mosquito/person/night. Meanwhile, *An. nigerimus* and *An.kochi* were exophagic. The biting activity of *An.nigerimus* peaked at 8 – 9 pm with its biting rate was 0.5 mosquito/person/night. *Anopheles kochi* biting activity peaked at 6 – 7 pm with its biting rate was 1.5 mosquito/person/night. *Aedes albopictus* was found at 6 - 7 pm with its biting rate was 2.5 mosquitoes/person/night. *Mansonia bonea* was exophagic. Its biting activity peaked at 11 – 12 pm with its biting rate was 2 mosquitoes/person/night. The average temperature and humidity of this study were 26.14 ± 0.30° and 94.60 ± 0.48%, respectively. *Culex sp.* usually rested inside the house in the morning. The breeding places of mosquitoes were puddle of water near house, water container, old/unused vehicles, footprint, and water tank. The water temperature of the breeding place was 25 °C. Its pH was 5.6 with 0 per mil salinity. This study did not found the vector of malaria, DHF, and filariasis. In conclusion, four genera of mosquitoes i.e. *Culex, Anopheles, Aedes* and *Mansonia* were found at Santu'un Village. However, vectors of malaria, DHF and filariasis were not found at this village.

Key words **:** *Culex - Anopheles - Aedes – Mansonia* - fauna - vector

ABSTRAK

Di Indonesia penyakit yang ditularkan oleh nyamuk seperti malaria, demam berdarah dengue (DBD), dan filariasis, masih merupakan masalah kesehatan utama masyarakat. Nyamuk yang menjadi vektor utama biasanya adalah *Aedes sp, Culex sp, Anopheles sp* dan *Mansonia sp*. Penelitian ini bertujuan mengetahui fauna nyamuk, bionomik dan kompetensi vektor nyamuk *Aedes sp, Culex sp, Anopheles sp dan Mansonia sp* di Desa Santu'un, Kecamatan Muara Uya, Kabupaten Tabalong, Kalimantan Selatan. Penangkapan nyamuk menggunakan aspirator dengan metode penangkapan Umpan Orang. Pembedahan nyamuk dilakukan untuk menemukan mikrofilaria sedangkan ELISA untuk menemukan sporozoit Plasmodium dan pemeriksaan imunohistokimia untuk menemukan virus dengue. Hasil penelitian menunjukkan bahwa *Cx. quinquefaciatus, Cx. tritaeniorhyncus, Cx. pipiens* dan *Cx. gelidus* bersifat eksofagik. *Culex quinquefaciatus* dan *Cx. tritaeniorhyncus* aktif menggigit pada jam 7-8 malam dengan kepadatan 102,5 dan 44,5 ekor/orang/malam. *Anopheles umbrosus* bersifat endofagik dan puncak menggigit jam 8-9 malam dengan kepadatan 0,5 ekor/orang/malam. *Anopheles nigerimus* dan *An. kochi* bersifat eksofagik. *Anopheles nigerimus* puncak menggigit pada jam 8-9 malam dengan kepadatan 0,5 ekor/orang/malam sedangkan *An. kochi* pada jam 6-7 malam dengan kepadatan 1,5 ekor/orang/malam. *Aedes albopictus* ditemukan jam 11-12 malam dengan kepadatan menggigit 2,5 ekor/orang/malam. *Mansonia bonea* bersifat eksofagik. Puncak menggigit pada jam 11-12 malam dengan kepadatan

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2 ekor/orang/malam. Suhu rata-rata selama penelitian 26,14 ± 0,30°C dan kelembaban rata-rata 94,60 ± 0,48%. *Culex sp*. umumnya beristirahat di pagi hari di dalam rumah. Tempat berkembangbiak nyamuk ditemukan di genangan air di dekat rumah, drum air, barang bekas kendaraan, pijakan kaki orang dan di bak air. Suhu air 25°C, pH 5,6 dan salinitas 0 permil. Dalam penelitian ini tidak ditemukannya nyamuk sebagai vektor penular penyakit malaria, DBD dan filariasis. Kesimpulan penelitian ini adalah ditemukan empat genera nyamuk yaitu *Culex, Anopheles, Aedes* dan *Mansonia* namun tidak ditemukan nyamuk sebagai vektor penyakit malaria, DBD maupun filariasis di Desa Santu'un.

Kata kunci **:** *Culex - Anopheles - Aedes – Mansonia* - fauna - vektor

INTRODUCTION

Santu'un Village is one of 11 villages which are located at Muara Uya Subdistrict, Tabalong District, South Kalimantan Province. This village has been categorized as malaria endemic area. In 2008-2009, the Annual Parasite Incidence (API) at Muara Uya Community Health Center was 2.82 per 1000 persons.[1] Moreover, one chronic filariasis and 23 DHF cases were also found and two deaths from DHF were reported in 2008-2009.[2] The control and management of vector-borne diseases have not been conducted at that village. These cause the number of mosquito-borne diseases especially malaria, DHF, and filariasis was quite high. Therefore, study in order to comprehend the species of mosquitoes that inhabit in Muara Uya Subdistrict, as well as the bionomic and the vector competence is needed. This study was conducted to comprehend the mosquitoes fauna, bionomical and vectorial competency of mosquitoes in Muara Uya Subdistrict.

MATERIALS AND METHODS

This study was an observational research using descriptive method. The measurement of temperature and humidity was conducted using thermometer and hygrometer, respectively. Global Positioning System (GPS) was used to measure the height of position. Survey of mosquito larvae was also performed. Mosquito capturing by Man Biting method using aspirator was performed at 6.00 pm – 6.00 am. The mosquito capturing was conducted by six persons at three houses which have been determined. Three persons captured the mosquitoes inside the houses and in the walls (indoor mosquito). Meanwhile, the other three persons captured the mosquitoes outside the houses and at the livestock cage (outdoor mosquito). The mosquitoes capturing was conducted once a month for 4 months.[3]

The dissection of mosquito was performed to find the microfilaria larvae. Enzyme-Linked Immunosorbent Assay (ELISA) of Plasmodium sporozoit of *Anopheles sp* was performed by using A Two-Site Sandwich technique.[4] The examination of dengue virus was performed by examining head squash preparats using immunohistochemistry which was previously described by Umniyati.[5] Descriptive analysis was conducted to make description of variables condition.

RESULTS

During this study, the average temperature and humidity were 26.14 ± 0.30°C and 94.60 ± 0.48 %, respectively. The frequency of captured mosquitoes is shown in TABLE 1.

TABLE 1. The frequency of captured mosquitoes in September 2010 - January 2011 at Santu'un Village, Muara Uya Sub District, Tabalong District, South Kalimantan

Genera	Month					Total
	September	October	November	December	January	n (%)
Anopheles	28	8	4	0	21	61 (5.7)
Culex	224	221	83	52	350	945 (89.2)
Mansonia	2	19	16	1	3	41 (3.9)
Aedes	1	0	3	2	2	8 (0.8)
Armigeres	0	1	0	0	3	4 (0.4)
Total	256	249	106	56	379	1.059 (100)

The biting activity of indoor mosquito indoor is shown in FIGURE 1. The biting activity of *Cx. quinquefaciatus* and *Cx. tritaeniorhynchus* was started at 18.00 and peaked at 21.00-22.00, with biting rate of 52 mosquitoes/person/night. Meanwhile, the biting activity of *Cx. tritaeniorhychus* was started at 23.00-24.00 with biting rate of 24.5 mosquitoes/person/night. This study also reported that the biting activity of *An. umbrosus* was at 20.00-21.00.

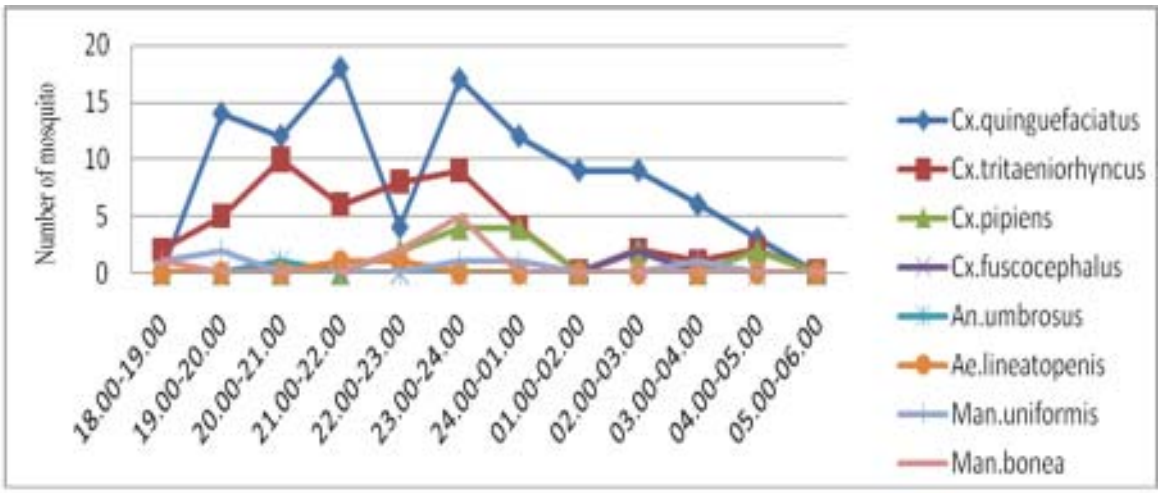

FIGURE 1. The biting activity of indoor (captured inside the house) *Culex sp, Anopheles sp, Aedes sp, Mansonia sp* at Santu'un Village, Muara Uya Sub district during September 2010 – January 2011

The biting activity of outdoor mosquito is shown in FIGURE 2. The biting activity of *Cx. quinquefaciatus* and *Cx. tritaeniorhynchus* was started from 18.00 and reached its peak at 19.00-20.00. The biting rate of both mosquitoes was 102.5 mosquitoes/person/night. Meanwhile, *Cx. tritaeniorhynchus* biting activity was at 22.00-23.00. The biting rate of this mosquito was 44.5 mosquitoes/person/night. *Culex pipiens* biting activity began at 22.00 and peaked at 24.00-01.00. Its biting rate was 13 mosquitoes/person/night.

Anopheles nigerimus and *An. kochi* were only can be found at early night, and their biting rate were 0.5 mosquito/person/night for *An. nigerimus* and 1.5 mosquitoes/person/night for *An. kochi*. Meanwhile, *Ae. albopictus* biting activity was at 23.00-24.00. The peak biting activity of *Man. uniformis* was at 20.00-21.00 and its biting rate was 4.5 mosquitoes/person/night. While *Man. bonea* biting activity was at 21.00-22.00 with its biting rate was 2 mosquitoes/person/night.

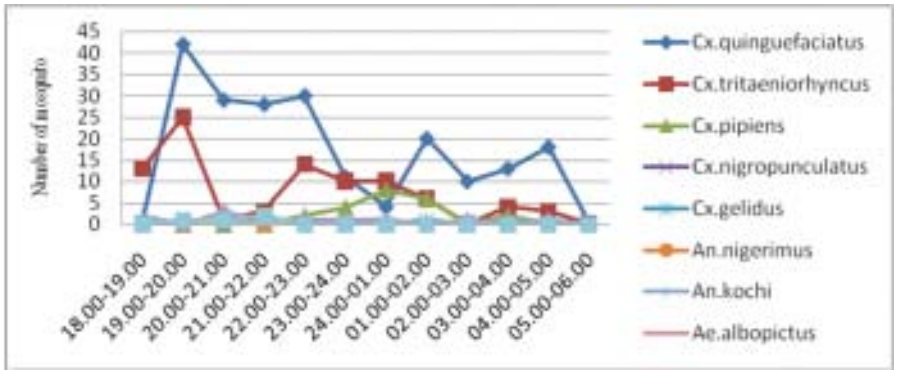

FIGURE 2. The biting activity of outdoor *Culex sp, Anopheles sp, Aedes sp, Mansonia sp* at Santu'un Village, Muara Uya Sub district during September 2010 – January 2011

The number of mosquito which was captured at the walls is shown in FIGURE 3. At night, *Cx. quinquefaciatus* was found to rest or sleep at walls. The biting rate of *Cx. quinquefaciatus* was 154 mosquitoes/person/night and it was higher compared to the biting rate of *Cx. tritaeniorhynchus* and *Cx. pipiens*. *Anopheles sp* which was captured at walls were *An. umbrosus, An. barbirostris* and *An. kochi*. *Ae. albopictus* was found resting or sleeping at walls at 23.00-24.00. The biting rate of *Ma. bonea* was 4 mosquitoes/person/night, while the biting rate of *Ma. uniformis* was 2 mosquitoes/person/night.

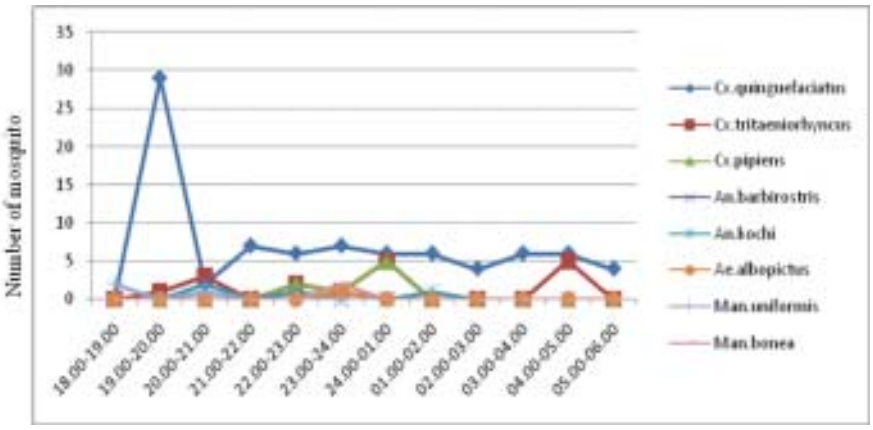

FIGURE 3. The number of *Culex sp, Anopheles sp, Aedes sp, Mansonia sp* which were captured at the walls at Santu'un Village, Muara Uya Sub district from September 2010 – January 2011

The number of mosquito which was captured at livestock cages is shown in FIGURE 4. *Culex quinquefaciatus* could be found at livestock cages at 23.00-24.00. Its biting rate was 164 mosquitoes/ person/night. *Anopheles sp* which was captured at livestock cages were *An. umbrosus, An. vagus, An. kochi, An. maculatus, An. tesselatus, An. nigerimus, An. sundaicus,* and *An. barbirostiris*. Most of *Anopheles sp* which were found at livestock cages were *An. kochi* and its biting rate was 54 mosquitoes/person/night. *Aedes sp* which were found at livestock cages were *Ae. vexian* and *Ae. lineatopenis*. *Mansonia bonea* and *Man. uniformis* also could be found at livestock cages.

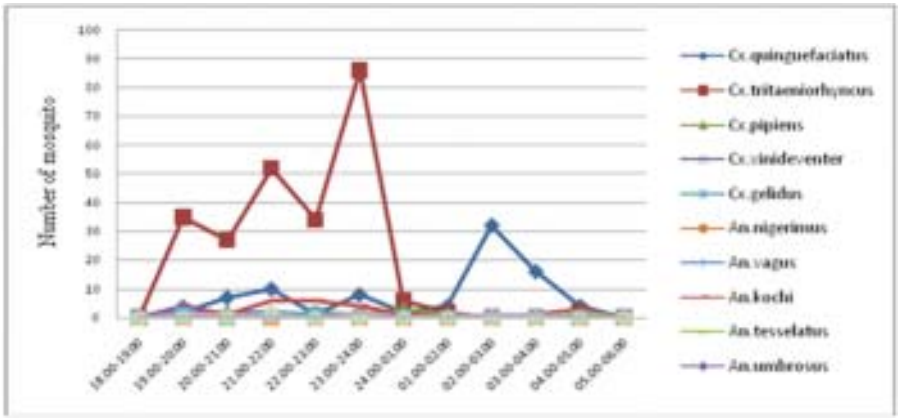

FIGURE 4. The number of *Culex sp, Anopheles sp, Aedes sp, Mansonia sp* which were captured at livestock cages at Santu'un Village, Muara Uya Sub district from September 2010 – January 2011

DISCUSSION

Anopheles umbrosus, An. nigerimus and *An. maculatus* were suspected as vector of malaria from six species of *Anopheles sp* which were assumed as malaria and filariasis vectors at South Kalimantan Province.[6] In this study, *An. umbrosus* was endophagic, while *An. nigerimus* and *An. kochi* were exophagic. *Anopheles barbirostris* was found to sleep and rest at walls. It was active both inside and outside the house with its biting activity peaked at 22.00-24.00.[7]

In this study, *An. maculatus* was found to rest at walls of houses. This mosquito preferred to bite animal than human, or zoophilic.[8] *Anopheles sundaicus* and *An. vagus* could be found near the livestock cages. *Anopheles sundaicus* was reported as malaria vector at other provinces, such as Yogyakarta, Riau, Lampung, Central Java, and East Java.[6] *Anhopheles vagus* was also reported as malaria vector at other regions.[9] This mosquito preferred to bite animal than human and commonly bite human at outside the house.[10]

Aedes lineatopenis was endophagic. Meanwhile. *Ae.albopictus* was exophagic and more active outside the house with its main host was human.[11] *Ae.albopictus* was the vector of dengue (DHF).[6] Its biting activity was at 08.00-12.00 in the morning and 15.00-17.00 in the afternoon.[12] However, this study reported that *Ae. albopictus* bit at night.

Mansonia uniformis was endophagic while *Ma. bonea* was more exophagic. Both species were the vector of filariasis at South Kalimantan Province.[12] This result was in accordance with the study by Lasbudi[13] which found that *Ma. uniformis* and *Ma. bonea* were active to bite human, either inside or outside the house. *Mansonia sp* was categorized as nocturnal mosquito which bite at night and its biting activity occurred from 12.00 to 03.00 a.m.

Culex sp which was captured when it rest inside the house in the morning were *Cx. quinquefaciatus, Cx. tritaeniorhynchus* and *Cx. pipiens*. During this study, there was no *Anopheles sp, Aedes sp* and *Mansonia sp* were captured in the morning, either inside or outside the house.

The result of mosquitoes dissection did not found any larvae of filariasis worm. This result might be caused by the small number of contact between human with *Culex sp* and *Mansonia sp*, especially *Cx. quinquefaciatus, Ma. uniformis* and *Man. bonea,* which were suspected as the vector of filariasis. The density, mosquito live span, and contact with human are the requirements of mosquitoes to become vector of filariasis. The infection of filariasis from mosquitoes to human is very different with the infection of malaria and dengue (DHF) to human. An individual could be infected by filariasis when she/he is bitten thousand times by vector mosquitoes.[14] This study did not perform ovary surgery to determine the age of mosquito. To act as the vector of filariasis, mosquitoes should have long life span, therefore the parasite could complete its life cycles in the mosquito. Furthermore, the number of microfilaria density in chronic filariasis patients was not identified. According to Sudjadi,[15] the minimum number of microfilaria in order to infect the vector and became contagious to other person was 15 microfilaria per 30 mm^3.

In this study, ELISA did not find any sporozoite in the body of *Anopheles*. This result might be caused by the low number of contact between mosquito and human, the short life span of *Anopheles*, or the low average of *Plasmodium* gametocyte of *Anopheles.* Based on the data of mosquito-capturing at night, only five *Anopheles* mosquitoes were reported to bite human. *Anopheles* could be suspected as malaria vector when there is high number of contact between this mosquito with humans, when the mosquito sucks blood for 2-3 times a day, and when the mosquito has long life span, therefore gametocyte could develop into sporozoite.[16]

This study only used small number of larvae stadium of *Ae. albopictus* which could explain the cause of negative result of immunohistochemistry of *Ae. albopictus*. The small number of larvae stadium of *Ae. albopictus* was caused by the low survival rate of *Ae. albopictus* imago in the laboratory. This factor became the weakness of this study. There was a difference in the transovarial infection rate (TIR) between egg, larvae, pupa, and imago stadiums. Larvae had the lowest TIR of DEN virus (22%) while imago had the highest TIR of DEN virus (96%).[17]

Three important factors which play role in the transmission of DEN virus infection are human, virus, and the vector.[18] Mosquito is infected by DEN

virus when it bites human whose blood contains DEN virus. The vertical transmission in mosquito happens when DEN virus is transmitted by infective female mosquito to its eggs (transovarial) that will become adult mosquito.[19-21]

The breeding places of *Culex sp* larvae were dirty water pond and water container. *Anopheles* larvae were found in water in old vehicle or unused vehicle, foot print, and water tank which grown by large frog and lily pad. *Aedes sp* larvae were found at unused tires and drums which often used to collect rainwater. Different species of mosquitoes choose different breeding places.[22]

CONCLUSION

This study showed that :

1. The genera of mosquitoes which were found in this study were *Culex, Anopheles, Mansonia* and *Aedes*. *Culex quinquefaciatus, Cx. tritaeniorhyncus, Cx. pipiens,* and *Cx.gelidus* were exophagic. *Anopheles umbrosus* was endopagic, while *An. nigerimus* and *An. kochi* were exophagic. *Mansonia uniformis* was endophagic while *Ma. bonea* was exophagic.
2. The mosquito biting activity and biting rate were different depending on the genera of mosquitoes.
3. The breeding places of mosquitoes were at puddle of water near the house, water container, unused vehicle, foot print, and water tank. The water temperature of those breeding places was 25^{o}C with the pH of the breeding places was 5.6 and 0 per mil salinity.
4. This study did not found mosquitoes as vector of malaria, dengue (DHF), and filariasis.

Further study to determine the disease vector is needed. The study in order to evaluate the fluctuation of vector density based on rainfall, peak season of the disease, and other factors which contribute in determining the malaria, DHF and filariasis vectors are also needed.

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