



Lymphatic Filariasis Control: School-based One Health Initiative on The Usage of Local Plants as Alternative Mosquito Repellants in Timor Tengah Selatan, Nusa Tenggara Timur

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Abstrak

Filariasis limfatik adalah penyakit yang ditularkan oleh nyamuk yang menimbulkan masalah kesehatan masyarakat yang serius. Penyakit ini telah menyebar ke 28 provinsi di Indonesia, dengan provinsi NTT menjadi salah satu dari 10 provinsi dengan insiden tertinggi. Selain sebagai pendukung utama program pemberian obat massal tahunan, inisiatif pengendalian nyamuk juga penting untuk pemberantasan penyakit. Namun, pendekatan pengendalian nyamuk saat ini terutama bergantung pada bagian sintetis, yang sayangnya, telah mengakibatkan masalah lingkungan dan juga resistensi pada spesies nyamuk yang penting. Oleh karena itu, perlu dikembangkan strategi pengendalian nyamuk alternatif berbasis komponen herbal yang ramah lingkungan, aman, dan tahan lama. Program one-health ini bertujuan untuk mengedukasi dan meningkatkan kesadaran masyarakat akan pentingnya pengendalian nyamuk serta menginspirasi masyarakat untuk memanfaatkan tanaman lokal sebagai alternatif pengusir nyamuk. Program ini menyoar siswa SMA se-Kabupaten Timor Tengah Selatan. Kabupaten ini merupakan salah satu kabupaten di NTT dengan risiko penyakit filariasis limfatik tertinggi. Metode pendekatan yang digunakan dalam program ini adalah serangkaian presentasi, diskusi, dan demonstrasi filariasis limfatik dan pemilihan tanaman lokal yang dapat digunakan sebagai penolak herbal. Berdasarkan diskusi dengan siswa, diketahui bahwa setelah mengikuti kegiatan ini, para peserta telah mempelajari dan mengenali fungsi ganda dari berbagai tanaman asli di daerah mereka sebagai pengusir nyamuk yang efektif dan hemat biaya. Selain itu, siswa menjadi lebih bersemangat untuk belajar dan mengembangkan pengetahuan tentang fungsi tanaman lokal lainnya sebagai pengusir nyamuk yang efisien.

Kata Kunci: Filariasis, Nyamuk, Repelan, Tumbuhan Lokal, Timor

Abstract

Lymphatic filariasis is a mosquito-borne disease that poses a serious public health concern. The disease has spread to 28 Indonesian provinces, with NTT province being one of the 10 provinces with the highest incidence. Aside from being a major supporter of the annual mass drug administration program, the mosquito control initiative is also critical to the disease's eradication. However, today's mosquito control approaches depend primarily on synthetic moieties, which, unfortunately, have resulted in environmental problems and also resistance in important mosquito species. Consequently, developing alternative mosquito control strategies based on herbal components that are environmentally friendly, safe, and long-lasting is necessary. This one-health program aims to educate and raise public awareness of the importance of mosquito control and to inspire the community to utilize local plants as alternative mosquito repellents. This program is targeted high school students from the Timor Tengah Selatan regency. This regency is one of the NTT regencies with the highest risk of lymphatic filariasis. The approach method employed in this program was a series of presentations, discussions, and a demonstration of lymphatic filariasis and the selection of local plants that can be used as herbal repellents. Based on discussions with the students, it was discovered that after engaging in this activity, the participants had learned and recognized the dual function of various indigenous plants in their area as effective and cost-effective mosquito repellents. Furthermore, the students became more excited to learn and develop knowledge about the function of other local plants as efficient mosquito repellents.

Keywords: Lymphatic Filariasis, Mosquito, Repellant, Local plants, Timor

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1. INTRODUCTION

Lymphatic filariasis (LF) or known as Elephantiasis is an important Neglected Tropical Disease (NTD) caused by microfilariae of filarial worms circulating in the ducts and lymph nodes of humans, leading to hydrocoele, lymphoedema, and elephantiasis (Babu & Nutman, 2014; Rebollo & Bockarie, 2014). There are three nematode worms from the family Filariodidea that are known as the primary causes of most LF infections worldwide, which are *Wuchereria bancrofti*, *Brugia malayi*, and *Brugia timori*. It is currently known that there are approximately 23 species of mosquitos of the genus *Culex*, *Anopheles*, *Aedes*, *Mansonia*, and *Armigeres* that serve as vectors of this disease (Bockarie et al., 2009; Cassidy et al., 2016). Though LF does not immediately cause death, its advanced stage can result in lifelong disability. Around 40 million people in the world are disabled or paralyzed due to this infection (Rebollo & Bockarie, 2017; Zeldenryk et al., 2011). Presently, LF has been recognized as a major cause of permanent disability around the globe. Affected people mostly are unable to work due to their impairment and negative stigma from their communities. Subsequently, there is reduced productivity which causing a social-economic burden and impacting the quality of life (Cassidy et al., 2016; Wynd et al., 2007).

This parasitic disease has infected 120 million individuals in 72 nations around the world and 1.3 billion people are at risk of contracting the disease, making it a serious global health issue in most of the tropic and sub-tropic areas of Asia, Africa, the Western Pacific, and parts of the Caribbean and South America (Gelolodo et al., 2021; Rebollo & Bockarie, 2017). Southeast Asia is estimated to account for 60% of all cases of filariasis. In Indonesia, LF endemics in 28 provinces (236 regencies) with the highest prevalent rate comes from the eastern part of Indonesia (Gelolodo et al., 2021; Hendryani, 2019). A study from previous research showed that a prevalence of Microfilariae rate (Mf rate) in Indonesia reached 19% of the total population (Ottesen, 2006). This finding implies that around 44.7 million people might have microfilariae in their bodies. In 2015 and 2016, Nusa Tenggara Timur (NTT) province was ranked first in Indonesia for LF cases, with a prevalence rate reaching 4.7 % in 2016. NTT then was ranked second after Papua in 2019. Currently, LF is known to be endemic in NTT including Timor Tengah Selatan (TTS) regency.

Recognizing the disease's significance, a Global Programme to Eliminate Lymphatic Filariasis (GPELF) was initiated by the World Health Organization (WHO) in 2000 to end LF as a global public health concern by 2020 (Hossain & Rahman, 2021; Rebollo & Bockarie, 2017). Two important concepts of WHO's LF strategic plan are: stopping the dissemination of the LF infection in endemic regions and reducing the discomfort of LF patients through the implementation of the recommended basic care package (Gbolade & Lockwood, 2008; Shukla et al., 2018; D. K. Singh & Singh, 2008). Preventive chemotherapy can stop the spread of this disease, thus, WHO advises the usage of mass drug administration (MDA) as preventive chemotherapy. Nevertheless, despite an estimation that the GPELF has prevented/treated more than 97 million LF cases worldwide and saved more than US\$100 billion in economic losses in 2015, many nations still lack sufficient funding to provide the vital services for LF prevention and control programs (Phasomkusolsil & Soonwera, 2010; Rajkumar & Jebanesan, 2009; Sato et al., 1996). Mosquito control is therefore suggested by the WHO as a supplement to large-scale preventative treatment, particularly in tropical climate regions, where various main mosquito species thrive (Tisgratog et al., 2016; Verma, 2016; Warikoo et al., 2012). Program for LF eradication LF is one of the public health concerns in Indonesia. LF eradication in Indonesia is carried out in accordance with the WHO's GPELF strategic plan (Amer & Mehlhorn, 2006; S. Singh et al., 2009; Soonwera & Phasomkusolsil, 2015).

Although measures to prevent and eradicate LF have been systematically carried out in Indonesia, particularly in NTT, NTT still has a relatively high incidence of LF. This is

considered to be driven by various significant elements, including environmental and socioeconomic factors (Gelolodo et al., 2021; Kouassi et al., 2018). As a tropical area rich in mosquito biodiversity, and with the availability of the filarial worm *Wuchereria bancrofti*, which is still commonly found in Eastern Indonesia likes NTT, and *Brugia timori*, which is solely found in NTT's archipelago, the risk of LF transmission in NTT remains fairly high (Bockarie et al., 2009; Yunarko & Patanduk, 2016). Furthermore, social and economic factors also influence the level of public awareness, understanding, and perception of LF. The community's knowledge of LF is still quite inadequate, in terms of the disease itself, vectors and transmission mechanisms, early symptoms, prevention, control, and treatment, which are thought to be stumbling blocks in the LF elimination strategy (Anees, 2008; Cox, 2005; Das et al., 2003). In addition to these two variables, the long-term development of insecticidal resistance in mosquitos as a result of synthetic insecticide use is an important factor influencing the success of mosquito control programs with synthetic insecticides (Amer & Mehlhorn, 2006; Amusan et al., 2005; Masuda et al., 2008). Therefore, low-cost natural vector control solutions that are biodegradable and environmentally friendly need to be studied and developed. Various studies have noticed that phytochemicals generated from local plant resources can be used as larvicides, regulators of insect growth, natural repellents, and ovipositional baits. Plant compounds have been utilized for centuries in many cultures to repel or kill insects (Das et al., 2003; Mathew, 2017; Sritabutra et al., 2011). Certain natural substances derived from local plants including Lemongrass (*Cymbopogon citratus*); Citronella (*Cymbopogon nardus*); Garlic (*Allium sativum*); Basil (*Ocimum sanctum*); and Orange (*Citrus Senesis*) have been researched for repellent efficacy against mosquitoes for decades (Murugan et al., 2012; Shukla et al., 2018; Sritabutra & Soonwera, 2013).

Regarding this phenomenon, it is critical to educate local people on the importance of LF preventive initiatives and what they can do to help eradicate the disease. Thus, health education is critical for disease prevention as it ensures that community members understand the etiology of the disease, the mechanisms of infection, the key actions or activities that must be addressed to prevent transmission, how to minimize the severity of disease, and to prevent the fatality. School-based health education is an important component of community education because it allows information and skills to be transferred from the classroom to the community. Moreover, by acquiring practical knowledge and skills on how to prevent the transmission of diseases through mosquito control, communities will be able to translate and integrate the knowledge into their everyday life. This initiative focuses on the education of vector control programs to high school students as elements of communities. The goal of this One Health campaign is to provide and exchange information on a variety of natural mosquito repellents produced from indigenous plants and their efficacy as effective, safe, and inexpensive herbal mosquito repellents.

2. METHODS

The target of this program is students in SMA Negeri 1 Amanuban Tengah, Timor Tengah Selatan, Nusa Tenggara Timur. The implementation of this school-based community outreach program is based on action research where the participants are given brief information about LF and its negative impacts, a mosquito control program, and a selection of local plants that can be used as mosquito repellants. The participants also are informed on how to utilize and process the plants into herbal repellants simply and effectively. This program consists of a sequence of presentations, a demonstration, and interactive discussions. A variety of supporting media such as videos, banners, and brochures have been used in this program. This program's performance evaluation is achieved in a descriptive qualitative approach based on the interaction and the class dynamic during the event.

Student responses will be monitored and examined throughout the activity to measure the effectiveness and success of the delivery methods that have been applied in this event. In the end, it is important to evaluate the entire project, from the planning to the execution.

3. RESULTS AND DISCUSSION

Results

This One Health-based activity was carried out for a day at SMA Negeri 1 Amanuban Tengah, Timor Tengah Selatan. The activity, which was attended by grade 12th students and several teaching staff, was divided into 2 sessions. The first session was designed to deliver basic information regarding LF infection and its causes. The second session focused on various local plants that can be exploited as natural repellants and their application techniques. A series of semi-formal presentations and a demonstration were used to carry out the community service activities with the students. Throughout the sessions, students were encouraged to think, ask questions, and share their ideas and perceptions on disease prevention initiatives and living habits in their community. Presentation and discussion activities were also designed to evaluate students' knowledge and perceptions before and after every session show in Figure 1.

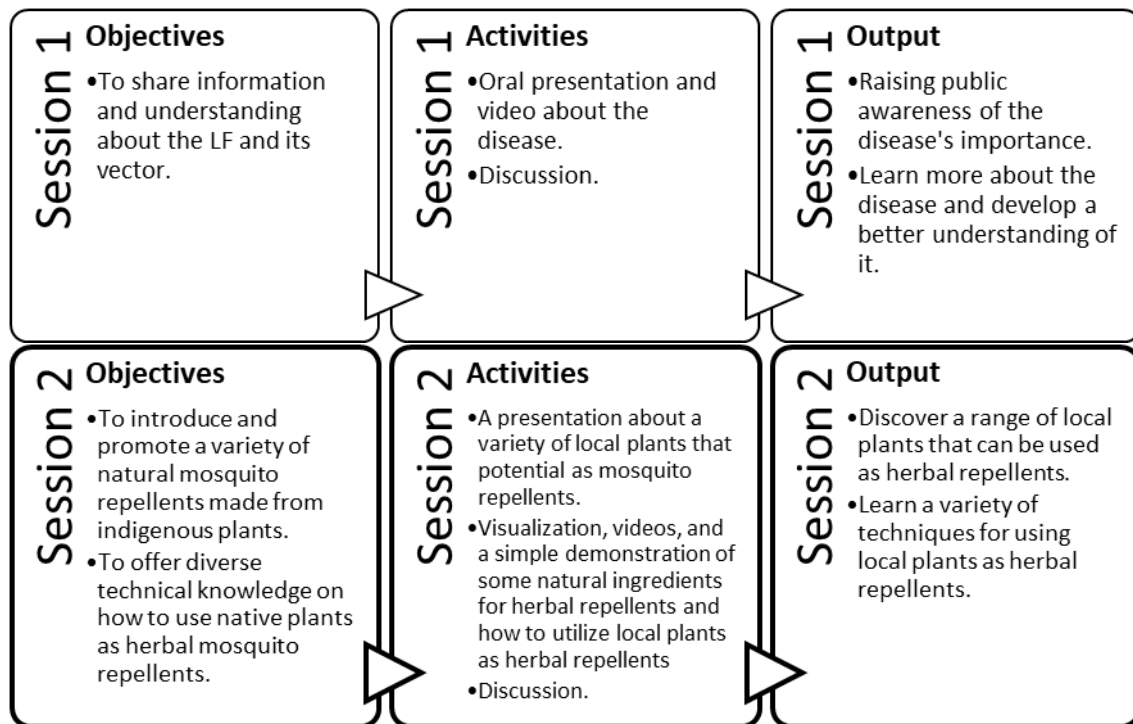


Figure 1. The program at SMA Negeri 1 Amanuban Tengah, Timor Tengah Selatan

Based on Figure 1 show several significant findings and results are important to address. One of the most significant findings based on the discussion and responses from the participants was information that the majority of the participants were unaware that mosquitoes are responsible for the transmission and spread of LF, although all participants had heard about LF. Another important and tangible outcome of the event was the dispelling of false beliefs and negative stigma about LF infection and its long-term care patients. Furthermore, the most exciting new information to the students and teachers was practical information and knowledge about a variety of local plants that can be exploited as mosquito

herbal repellants. The participants agreed that the simple and practical method for preparing herbal repellent from local plants could well be applied to everyday life.

For generations, traditional pesticides have been produced using crude botanical extracts from plant leaves, flowers, seeds, roots, and bark. The phytochemicals generated from plants or particular parts of plants using various techniques can operate as a toxicant, growth regulator, repellent, and ovipositional inhibitor against mosquitoes. Thus, plant-based products are valuable natural substitutes for insecticides. Several local plants such as Lemongrass (*Cymbopogon citratus*); Citronella (*Cymbopogon nardus*), Garlic (*Allium sativum*), Basil (*Ocimum sanctum*), and Orange (*Citrus senesis*), all of which are commonly found in the mountainous region of Timor Tengah Selatan, were introduced to the participants due to their effectiveness as natural repellents and easy and low-cost applications.

Lemongrass (*C. citratus*) is widely used as a mosquito repellent around the world, and the compositions tested cover a wide effective concentration range. Lemongrass, similar to other *Cymbopogon* plants, is known for repelling *Anopheles* sp. which are vectors of LF. Next, there is a species from *Alliaceae* family, garlic (*Allium sativum*) that is generally recognized as a valuable spice and a famous treatment for a wide range of diseases. Garlic produces a variety of sulphur-based components that are effective insect repellents and insecticides. One of the local plants that have potential as mosquito natural repellent and larvicide is basil (*Ocimum sanctum*). Basil's mosquitocidal effect is primarily influenced by eugenol and triglyceride activity. Some researchers have found that basil is effective against larva of *A.aegypti*, and *C. quinquefasciatus*. Basil has also been shown to successfully repel three types of mosquitos (*Anopheles* sp., *Culex* sp., and *Aedes* sp.). In the Rutaceae family, *Citrus* has approximately 17 species that are found in tropical and subtropical areas. Citrus seeds, fruits, leaves, and roots have all been studied for their effectiveness as mosquitocidal agents. Peels of citrus are the most well-known and richest source of quality essential oils among other parts of citrus

In addition to providing information about local plants that can be used as a natural alternative to mosquito repellent, the participants were also provided with presentations, a demonstration, and videos about simple techniques for using these plants so that they function as safe and inexpensive mosquito repellents. In this campaign, the participants were informed that the simplest thing to do is to cultivate these local plants around their houses and neighbourhoods. As indoor plants, the plants can be placed in the corners of the room to serve as a mosquito repellent medium. While for placement outside the home, it should be positioned near a door, window, or other air vents so that the scent of plants is delivered by the air into the room. [Figure 2](#) show community service conducted at SMA Negeri 1 Amanuban Tengah.



Figure 2. Activities at SMA Negeri 1 Amanuban Tengah, Timor Tengah Selatan

Discussion

Base on the result show that all participants agreed that all the information was valuable and useful to them. In this project, students and teachers were exposed to numerous types of local plants that are abundant and easy to find in their environment and everyday lives and are scientifically known to have the potential to be employed as natural repellents. Several plants have been reported to be selective, with little or no adverse effects on non-target organisms and the environment.

Some natural plants described in this service have chemical compounds are known to have physiological and behavioural impacts, such as poisons, repellents, feeding deterrents, attractants, insect development regulators, and hormones (Husna et al., 2020; Kalu et al., 2010). The active ingredients in those plants will interfere with the mosquitoes' ability to recognize human attractant substances by blocking the sensory function. As a result, it will protect individuals from mosquito bites. Essential oils extracted from a variety of plants have been demonstrated to be effective repellents towards a range of hematophagous arthropods, particularly mosquitoes, and thus are perceived to be friendlier than synthetic compounds such as pyrethroids (Diop et al., 2017; Michael et al., 2004). Several local plants such as Lemongrass (*Cymbopogon citratus*); Citronella (*Cymbopogon nardus*), Garlic (*Allium sativum*), Basil (*Ocimum sanctum*), and Orange (*Citrus senesis*),

Those findings demonstrated the usefulness of natural products in suppressing mosquitos and their mortality features since they are considered environmentally acceptable and eco-friendly approaches for mosquito control programs. The cultivation of this mosquito repellent plant is projected to bring multipurpose benefits, as a medicinal plant and as a plant mosquito repellent. This basic counselling is expected to assist the community in recognizing and understanding the value of natural repellent, as well as to provide a more realistic picture of the application of this simple technology in their daily life.

It is in line with previous study that explored the effects of *Jatropha curcas* leaf extract and *Bacillus thuringiensis israelensis* larvicidal activity against the lymphatic filarial vector, *Culex quinquefasciatus* (Kovendan et al., 2011). The result of this study suggest methanol extracts of *J. curcas* and *B. thuringiensis israelensis* have potential to be used as an ideal eco-friendly approach for the control of the major lymphatic filarial vector, *C. quinquefasciatus*. It is also reinforce by other previous research that conduct survey of medicinal plants used against lymphatic filariasis in the Eastern Cape, Free State, KwaZulu-Natal and Mpumalanga Provinces of South Africa (Komoreng et al., 2017). The result was interesting to note that different traditional healers from the four Provinces use similar plants to treat lymphatic filariasis. The most frequently mentioned plants were *Elephantorrhiza elephantina*, *Eucomis autumnalis*, *Ganoderma* sp., *Solanum aculeastrum*, *Hermannia geniculata*, *Datura stramonium* and *Pentanisia prunelloides*.

Moreover, in order to attain a community that is aware of its health and the environment, several approaches should be occupied to make this type of work sustainable and accepted in communities, including conducting dialogue with stakeholders from project planning to final evaluation, incorporating local wisdom and resources into project activities, planning future potential collaboration projects based on community needs, and building positive communication with stakeholders.

4. CONCLUSION

This project demonstrates that, prior to this engagement, many students were unaware of the dual function of some native plants in their environment as effective and economical mosquito repellent plants. However, after participating in this activity, the students learned and understood the dual function of several indigenous plants in their area as effective and

cost-effective mosquito repellents, according to discussions with the students. In addition, the students got more interested in getting to know about the function of other local plants as effective mosquito repellents and expanding their knowledge. Moreover, this initiative has also succeeded in demonstrating that, according to local knowledge, there are several other native plants that are believed to have a similar effect to mosquito repellents. Therefore, in addition to disseminating research-based practical information to the community, similar activities should be carried out on a regular basis to raise public awareness of the importance of healthy lifestyles and to explore local knowledge about the potential of herbal plants in the community.

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