

Testing the Effectiveness of Galanga Leaf Extract (*Alpinia Galanga*) on *Culex Sp* Larva Death

Apriyani Pramudiyawati Yunar^{1*}, Reni Anggraeni², Rita Putri Wati³,
Panduwita⁴, An'nisaa Heriyanti⁵

¹Akademi Farmasi Persada Sukabumi

²Poltekes Yapkesbi Sukabumi

^{3,4,5}Akbid Bakti Indonesia Bogor

Corresponding Author: Apriyani Pramudiyawati Yunar

apriyanipramudiyawatiyunar@gamai.com

ARTICLE INFO

Keywords: Galangal Leaf Extract (*Alpinia Galanga*), *Culex Sp* Larvae

Received : 20, March

Revised : 21, April

Accepted: 22, May

©2024 Yunar, Anggraeni, Wati, Panduwita, Heriyanti: This is an open-access article distributed under the terms of the [Creative Commons Attribution 4.0 International](https://creativecommons.org/licenses/by/4.0/).



ABSTRACT

For information to the public in efforts to improve sanitation to control mosquitoes by using Clove Leaf Extract (*Syzygium aromaticum*) as a biological insecticide because traditional control does not harm health, the material is easy to obtain and is environmentally friendly. This research aimed to determine the effectiveness of galangal leaf extract (*Alpinia galanga*) on the death of *Culex sp* larvae. From the research results, from 91 ml of galangal leaf extract, a p-value coefficient of 0.03 was obtained, where the p-value <0.05 means the relationship between galangal leaf extract and larval death. From 92 ml of galangal leaf extract, a p-value coefficient of 0.03 was obtained, where the p-value <0.05 means the relationship between galangal leaf extract and larval death. From 93 ml of galangal leaf extract, a p-value coefficient of 0.06 was obtained, where the p-value <0.05 means the relationship between galangal leaf extract and larval death. From 94 ml of galangal leaf extract, a p-value coefficient of 0.00 was obtained, where the p-value <0.05 means the relationship between galangal leaf extract and larval death. It is hoped that the public can use galangal leaf extract solution in breeding places for *Culex sp* mosquitoes such as water reservoirs, used tires, etc.

INTRODUCTION

Many infectious diseases have been able to be overcome and some have even been eradicated thanks to technological advances in overcoming biological environmental problems which are closely related to infectious diseases; however, the problem of infectious diseases is still felt by the majority of the population of developing countries such as Indonesia. One of them is the problem of infectious diseases which are transmitted through mosquito vectors (Noor, 2018 in Maesaroh, 2017).

In Indonesia, diseases transmitted through mosquito vectors are endemic in certain areas, including dengue hemorrhagic fever (DHF), malaria, elephantiasis (filariasis), and chikungunya (Chandra, 2019). Filariasis or elephantiasis is an infectious disease caused by infection with filarial worms which live in the lymph channels and glands and cause acute or chronic symptoms. This disease is chronic (chronic) and if not treated can cause permanent disabilities in the form of enlargement of the legs, arms, and genitals in both women and men. As a result, sufferers cannot work optimally and even depend on other people for their lives, thus becoming a burden on the family, community, and state (P2B2 Banjarnegara Research and Development Workshop Staff, 2019). Based on reports from all provinces in 2009, the provinces with the highest number of filariasis cases were Nanggroe Aceh Darussalam (2,359 people), East Nusa Tenggara (1,730 people) and Papua (1,158 people). The three provinces with the lowest cases are Bali (18 people), North Maluku (27 people) and North Sulawesi (30 people). The incidence of filariasis in Aceh Province is very prominent when compared with other provinces and is the province with the highest number of cases in all of Indonesia (MOH RI, 2015).

LITERATURE REVIEW

Many infectious diseases have been able to be overcome and some have even been eradicated thanks to technological advances in overcoming biological environmental problems which are closely related to infectious diseases, however, the problem of infectious diseases is still felt by the majority of the population of developing countries such as Indonesia. One of them is the problem of infectious diseases which are transmitted through mosquito vectors (Noor, 2018 in Maesaroh, 2017).

In Indonesia, diseases transmitted through mosquito vectors are endemic in certain areas, including dengue hemorrhagic fever (DHF), malaria, elephantiasis (filariasis), and chikungunya (Chandra, 2019). Filariasis or elephantiasis is an infectious disease caused by infection with filarial worms which live in the lymph channels and glands and cause acute or chronic symptoms. This disease is chronic (chronic) and if not treated can cause permanent disabilities in the form of enlargement of the legs, arms, and genitals in both women and men. As a result, sufferers cannot work optimally and even depend on other people for their lives, thus becoming a burden on the family, community, and state (P2B2 Banjarnegara Research and Development Workshop Staff, 2019).

Based on reports from all provinces in 2009, the provinces with the highest number of filariasis cases were Nanggroe Aceh Darussalam (2,359

people), East Nusa Tenggara (1,730 people) and Papua (1,158 people). The three provinces with the lowest cases are Bali (18 people), North Maluku (27 people) and North Sulawesi (30 people). The incidence of filariasis in Aceh Province is very prominent when compared with other provinces and is the province with the highest number of cases in all of Indonesia (MOH RI, 2015). Based on reports from all provinces in 2009, the provinces with the highest number of filariasis cases were Nanggroe Aceh Darussalam (2,359 people), East Nusa Tenggara (1,730 people) and Papua (1,158 people). The three provinces with the lowest cases are Bali (18 people), North Maluku (27 people) and North Sulawesi (30 people). The incidence of filariasis in Aceh Province is very prominent when compared with other provinces and is the province with the highest number of cases in all of Indonesia (MOH RI, 2015).

In 2008 in West Java, 980 people were suffering from elephantiasis, especially in Banjaran, Soreang, and Majalaya sub-districts, Bandung Regency, where the number reached 450 people. Until 2008, the cumulative number of chronic cases of filariasis was reported to be 11,699 cases in 378 districts/cities (Ministry of Health of the Republic of Indonesia, 2011). Based on P2PL, the Sukabumi District Health Service, the number of filariasis sufferers in 2013 was 106 cases spread across two Community Health Centers, namely Sagaranten with 36 cases and Curug Kembar Community Health Center with 15 cases of elephantiasis (Republika.co.id, 2016). Filariasis is a health problem in Indonesia. One of the influences on the occurrence of filariasis is globalization and the increasing population. With the increase in population, the breeding and breeding places for *Culex* sp mosquitoes are also increasing. Where these mosquito larvae like to live in puddles of clean water and dirty water so that the density of *Culex* sp larvae is higher.

Controlling disease vectors is a priority in disease control efforts because the potential for transmitting diseases is very large, such as flies, mosquitoes, mice and other insects. Vector control activities can include spraying, biological control, eradicating mosquito nests and improving the environment (Bapelkes Cikarang, 2012). Controlling disease vectors is a priority in disease control efforts because the potential for transmitting diseases is very large, such as flies, mosquitoes, mice, and other insects. Vector control activities can include spraying, biological control, eradicating mosquito nests, and improving the environment (Bapelkes Cikarang, 2012). Efforts to control vectors, especially mosquitoes, can start from controlling their larvae. Control of mosquito larvae usually uses larvicide containing the active ingredient temephos (an organophosphate group). Cumulative use of chemicals will hurt humans and the environment, for this reason, an effort is needed to obtain alternative insecticides that are safe for humans and the environment (Husna, et al, 2019).

One alternative that people can do is use plants as natural insecticides that are environmentally friendly and do not harm humans. Galangal (*Alpinia galanga*) is a long-lived plant, about 1-2 meters high. Usually grows in tight clumps. Galangal leaves are toxic and repellent and have been tested against *Daucus caudatus*, *Manduca sexta*, and Aphids, besides having nematocidal activity (Nursal and Etti, 2005). And galangal also has active ingredients in the form of tannins, saponins, alkaloids, and flavonoids which can be used to

control insects (Husna, et al, 2012). Alkaloids and saponins act as stomach poison or toxins that enter through the mosquito's mouth. Alkaloids can cause digestive system disorders in larvae, apart from that, saponins also have a bitter taste so they reduce the larvae's appetite and then the larvae will die of starvation (Minarni, et al, 2013). Tannins will bind proteins in the digestive system so that the process of protein absorption is disrupted in the digestive system. Flavonoids enter the insect's body through inhalation which will then cause damage to the respiratory system (Hariani, 2014).

Based on research by Nursal and Etti Sartina Siregar (2005) regarding the chemical compound content of galangal leaf extract (*Lactuca indica* L) toxicity and its sublethal effect on the mortality of *Aedes aegypti* mosquito larvae, galangal leaf extract will kill *Aedes aegypti* larvae. At a concentration of 0.93%, it reaches 96.15% and at a concentration of 1.86%, it reaches 100%. Apart from that, the results of research conducted by Husna, et al (2012), regarding the efficacy of galangal leaf extract on the mortality of *Anopheles aconites* mosquito larvae, at concentrations of 4.4% and 5.1% galangal leaf extract can kill the population of *Anopheles aconites* mosquito larvae up to 50 times. % and 90%.

METHODOLOGY

The type of research carried out was real experimental research (True experimental design) because the researchers carried out intervention/treatment on several test and control larvae to determine the difference between giving galangal leaf extract and the death of *Culex* sp larvae. The research design used was pretest-posttest with a control group (pretest-posttest with control group). In this design, there is a grouping of members of the control group and the experimental group. Then a pretest (1) was carried out in the two groups and followed by treatment (X) in the experimental group, after some time a posttest (2) was carried out in the two groups.

The population in this study was 250 *Culex* SP larvae taken from RT 03 RW 14 Sukaraja District, Sukabumi Regency, and then filled into each container. The sample is the part or number and characteristics possessed by the population. If the population is large, and it is impossible for the researcher to study everything in the population, for example, due to limited funds, energy, and time, then the researcher will take samples from that population. What is learned from the sample, the conclusions will be applied to the population. For this reason, samples taken from the population must be truly representative (Sugiyono, 2011).

The following are the research samples, among others:

1. The research sample consists of 5 containers
2. Then 4 containers were given Galangal Leaf Extract (*Alpnia galanga*)
3. Each container with a dose of 91ml, 92ml, 93ml, 94ml.
4. One container was not given Galangal Leaf Extract (*Alpnia galanga*) as a control without treatment.
5. Each container is filled with 10 *Culex* sp larvae
6. Then observations were made with 5 repetitions.

In this study, the sample size taken was 250 Culex sp larvae taken from RT 03 RW 14 Sukaraja District, Sukabumi Regency.

a. Tools and materials

- 1) Dropper pipette
- 2) Flashlight
- 3) Container/Jar
- 4) pH meter/indicator stick
- 5) Gauze
- 6) Rubber

b. Collection procedure:

- 1) Look for places that are breeding places for Culex SP mosquito larvae. Used goods that can collect rainwater in ponds that are no longer in use.
- 2) The larva is put into a container/jar using a pipette.
- 3) After inserting the larva, the container/jar is covered with gauze and rubber.

RESEARCH RESULT

The results of the research "testing the effectiveness of galangal leaf extract (Alpina galanga) on the death of Culex SP larvae" are presented in table form as follows:

Univariate Analysis Results

Table 1. The number of deaths of Culex SP larvae was 91 ml

Repetition	Dose	Time (minute)	\sum Death of Larvae	pH	Temperature
control	-	60	0	7	25°C
1	91ml	60	3	5	25°C
2	91ml	60	3	5	25°C
3	91ml	60	4	5	25°C
4	91ml	60	3	5	25°C
			$X_1 = 13$	5	

Based on the results of the research in the table above, treatment of 91ml of galangal leaf extract (Alpina galanga) for 5 repetitions found that 13 mosquitoes died, with details in control 1 as many as 3, in control 2 as many as 3, in control 3 as many as 4. , in control 4 there were 3 animals.

Table 2. The number of deaths of Culex SP larvae was 92 ml

Repetition	Dose	Time (minute)	\sum Death of Larvae	pH	Temperature
control	-	60	0	7	25°C
1	92 ml	60	5	5	25°C
2	92 ml	60	6	5	25°C
3	92 ml	60	6	5	25°C
4	92 ml	60	5	5	25°C
			$X_1 = 22$	5	

Based on the results of the research in the table above, 92ml of galangal leaf extract (alpnia galanga) was treated for 5 repetitions, 22 dead larvae were found, with details in control 1 as many as 5, in control 2 as many as 6, in control 3 as many as 6 , in control 4 there were 5 animals.

Table 3. The number of deaths of Culex SP larvae was 93 ml

Repetition	Dose	Time (Minute)	\sum Larval Death	pH	Temperature
Control	-	60	0	7	25°C
1	93ml	60	7	5	25°C
2	93ml	60	7	5	25°C
3	93ml	60	8	5	25°C
4	93ml	60	9	5	25°C
			$X_1 = 31$		

Based on the results of the research in the table above, 93ml of galangal leaf extract (Alpina galanga) was treated for 5 repetitions and 31 dead larvae were found, with details in control 1 as many as 7, in control 2 as many as 7, in control 3 as many as 8. , in control 4 there were 9 animals.

Table 4. The number of deaths of Culex SP larvae was 94 ml

Repetition	Dose	Time (minute)	\sum Death of Larvae	pH	Temperature
control	-	60	0	7	25°C
1	94 ml	60	10	5	25°C
2	94 ml	60	9	5	25°C
3	94 ml	60	10	5	25°C
4	94 ml	60	10	5	25°C
			$X_1 = 39$		

Based on the results of the research in the table above, 94 ml of galangal leaf extract (Alpina galanga) was treated for 5 repetitions and 39 dead larvae were found, with details in control 1 as many as 10, in control 2 as many as 9, in control 3 as many as 10. , in control 4 there were 10 animals.

Bivariate Analysis Results
Homogeneity Test Results

Table 5. Homogeneity Test Results Variants of the effectiveness of galangal leaf extract (alpnia galanga) on the death of Culex SP larvae

Levene Statistic	df1	df2	Sig.
1.714	3	12	217

Primary data from calculations using Spss 2016

From Table 5.5, the Levene Statistics figure is 1,714 with a significance/probability (sig) of 0.217. Because the calculated probability/significance number is > 0.05 ($0.241 > 0.05$); then H_0 is accepted and H_a is rejected. In conclusion, the four concentration variants used in the compared treatments are the same. Thus the assumption of equality of variance for the ANOVA treatment is met. (Sarwono, 2015)

Anova Test

Table 6. Results of Anova Test Analysis of Treatment Doses of Galangal Leaf Extract (Alpnia Galanga) on the Death of Culex SP Larvae

	Sum Squares	of Df	Mean Square	F	Sig.
Between Groups	94.688	3	31.562	72.143	.000
Within Groups	5.250	12	.438		
Total	99.938	15			

Primary data from calculations using Spss 2016

The table above gives a significant value of 0.000, which is smaller than $\alpha = 0.05$, so the research hypothesis is accepted, meaning that with 5 repetitions with doses of 91ml, 92ml, 93ml, and 94ml there is a significant effect in killing Culex SP larvae. Based on the analysis of the ANOVA calculation results because it shows that H_0 is rejected, and H_a is accepted, there is a difference, this test is continued with a Post Hoc test. The test compares the average numbers between treatment groups at the real level $\alpha=0.05$ which can be seen in the following table:

Post Hoc Test Results

Table 7. Comparative Analysis of Differences in Doses of Galangal Leaf Extract (Alpnia Galanga) by Various Treatments

No	treatment group	treatment group	Beda Rata - rata	P -Value
1	91ml	92ml dose	-2.25000*	.003
		dose 93 ml	-4.50000*	.000
		dose 94 ml	-6.50000*	.000

2	92ml	dose 91 ml	2.25000*	.003
		dose 93 ml	-2.25000*	.003
		dose 94 ml	-4.25000*	.000
3	93ml	91ml dose	4.50000*	.000
		dose 92 ml	2.25000*	.003
		dose 94 ml	-2.00000*	.006
4	94ml	dose 91 ml	6.5000*	.000
		dose 92 ml	2.2500*	.000
		dose 93 ml	2.0000*	.006

Based on the table above in the Post Host Analysis ANOVA test in the 91ml treatment with a p-value coefficient of 0.00 where the p-value <0.05, there is an effect of the 91ml dose on larval death.

Based on the table above in the Post Host Analysis ANOVA test, in the 92 ml treatment with a p-value coefficient of 0.03, where the p-value <0.05, there is an effect of the 92 ml dose on larval death.

Based on the table above in the Post Host Analysis ANOVA test, in the 93ml treatment with a p-value coefficient of 0.006 where the p-value <0.05, there is an effect of the 93ml dose on larval death.

Based on the table above in the analysis of the Post Host Anova test in the 94 ml treatment with a p-value coefficient of 0.000 where the p-value <0.05, there is an effect of the 94 ml dose on larval death.

DISCUSSION

In this study, it can be seen from Table 5.1 above that based on the number of deaths of Culex SP larvae, it proves that there is an influence of galangal leaves (*Alpina galanga*) on the death of Culex SP mosquito larvae in each treatment given galangal leaf extract (*Alpina galanga*), because in the galangal leaf extract (*Alpina galanga*) contains toxic substances for insects such as flavonoid chemical compounds.

From research conducted by the author, galangal leaf extract (*alpina galanga*) has been proven effective as a Culex SP mosquito larvicide which can inhibit the growth and kill Culex SP mosquito larvae. The concentration of galangal leaf extract (*alpina galanga*) given to each treatment with repetition 4 times, namely 91 ml, can kill 13 *Aedes Aegypti* larvae. Meanwhile, a 92ml dose can kill 22 Culex SP larvae, a 93ml dose can kill 31 larvae and a 94ml dose can kill 39 larvae. For the control (not using galangal leaf extract (*alpina galanga*)) there were no deaths in Culex SP mosquito larvae.

Judging from the four concentrations above, it is very clear that there is a difference between the control without treatment and using the treatment which is shown in the results of the analysis using the SPSS computer program (software). The ANOVA test in Table 5.2, doses of 91ml, 92ml, 93ml, and 94ml, gives a calculated F value of 72.143 with a significance value. 0.000 because the significance value is smaller than $\alpha=0.05$, the research hypothesis is accepted.

CONCLUSIONS AND RECOMMENDATIONS

The results obtained from 91 ml of galangal leaf extract using the post hoc test, and ANOVA test obtained a p-value coefficient of 0.03 where the p-value <0.05 means the relationship between galangal leaf extract and larval death. Thus the research hypothesis is accepted.

The results obtained from 92 ml of galangal leaf extract using the post hoc test, and ANOVA test obtained a p-value coefficient of 0.03 where the p-value <0.05 means the relationship between galangal leaf extract and larval death. Thus the research hypothesis is accepted.

The results obtained from 93 ml of galangal leaf extract using the post hoc test, and ANOVA test obtained a p-value coefficient of 0.06 where the p-value <0.05 means the relationship between galangal leaf extract and larval death. Thus the research hypothesis is accepted.

The results obtained from 94 ml of galangal leaf extract using the post hoc test, and ANOVA test obtained a p-value coefficient of 0.00 where the p-value <0.05 means the relationship between galangal leaf extract and larval death. Thus the research hypothesis is accepted.

ADVANCED RESEARCH

With the results of this research, it is hoped that it can add reading or reference materials to the Persada Sukabumi Pharmacy Academy library. This research suggests that when carrying out activities in the field such as health outreach and health promotion, they can provide materials that can introduce traditional plants that can be used as alternatives to kill mosquitoes or mosquito larvae, increase the number of plants that can It functions as a vegetable insecticide, one of which is garlic which is easy to obtain, environmentally friendly and safe for human health.

In future research, larger numbers of larvae should be used so that the data obtained is more representative. Further research needs to be carried out regarding the duration of the influence of the galangal leaf solution on *Aedes aegypti* larvae. Further research needs to be carried out regarding the preparation of a galangal leaf extract solution that is more applicable to the public.

It is hoped that the community can use galangal leaf pti solution in breeding places for *Aedes aegypti* mosquitoes such as water reservoirs, used tires, etc. Providing information to the public in the form of posters or brochures containing the benefits of kemagi leaf extract which can be used as a vegetable insecticide to control the *Aedes aegypti* mosquito population.

REFERENCES

- Alfiah. 2008. *Pengaruh Ekstrak Metanol Daun Sirsak (Annona muricata Linn) Terhadap Daya Netas Telur, Mortalitas dan Perkembangan Larva Aedes aegypti Linn*. Skripsi: Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Sumatera Utara. Diakses tanggal 04 Februari 2018. <http://repository.usu.ac.id>.
- Artha, Elza. 2012. Pengaruh Faktor Fisik, Kimis, Biologi Air dengan Keberadaan Tumbuhan Eceng Gondok (*Eichornia crassipes*) Terhadap Perkembangbiakan Nyamuk Anopheles sp di Perairan Danau Toba. Tesis: Fakultas Kesehatan Masyarakat Universitas Sumatera Utara. Diakses tanggal 04 Februari 2018. <http://repository.usu.ac.id>.
- Bapelkes. 2012. Modul Pelatihan Pengendalian Vektor di Daerah Tanggap Darurat. Cikarang. Diakses tanggal 04 Februari 2018.
- Barlina, Tajnaz. 2014. Pengaruh Berbagai Konsentrasi Ekstrak Daun Tomat (*Solanum lycopersicum*) Terhadap Kematian Larva Culex sp. Karya Tulis Ilmiah Jurusan Kesehatan Lingkungan Poltekkes Bandung.
- Chandra, Budiman. 2007. Pengantar Kesehatan Lingkungan. Cetakan 1. Jakarta: EGC.
- Dahlan, M.Sopiyudin. 2013. Statistik Untuk Kedokteran dan Kesehatan. Edisi 5. Cetakan Ketiga. Jakarta: Salemba Medika.
- Depkes RI. 2009. Mengenal Filariasis (Penyakit Kaki Gajah). Diakses tanggal 06 Februari 2018.
- Direktorat Jenderal Pengendalian Penyakit dan Penyehatan Lingkungan. 2012. Pedoman Penggunaan Insektisida (Pestisida) Dalam Pengendalian Vektor. Kementerian Kesehatan Republik Indonesia.
- Gomez, Kwancai A dan Arturo A, Gomez. 2007. Prosedur Statistik Untuk Penelitian Pertanian. Edisi Kedua. Jakarta: Universitas Indonesia.
- Hairani, Shovichah. 2014. Efektifitas Ekstrak Daun Mundu (*Garnicia dulcis*) Sebagai Larvasida Nyamuk Culex quinguefascuiatus dan Aedes aegypti. Fakultas Kedokteran Hewan Institut Peranian Bogor. Diakses tanggal 04 Februari 2018. <http://Academia.Edu>.
- Nasional.republika.co.id. 2013. 106 Warga Sukabumi Terserang Kaki Gajah. (onlone). Diakses tanggal 30 Januari 2018. <http://nasional.republika.co.id/berita/nasional/jawa-barat-nasional/13/02/22/mim4rr-106-warga-sukabumi-terserang-kaki-gajah>.
- Husna, Syarifah dkk. 2012. Efikasi Ekstrak Daun Lengkuas Terhadap Mortalitas Larva Nyamuk Anopheles aconitus. Semarang: Tersedia: Diakses tanggal 15 Februari 2018. <http://journal.unnes.ac.id/sju/index.php/ujls>.
- Ishartadiati, Kartika. (Tanpa Tahun). Resistensi Serangga Terhadap DDT. Diakses tanggal 21 Februari 2018).

- Komisi Pestisida Departemen Pertanian. 1995. Metode Standar Pengujian Efikasi Pestisida. Jakarta.
- Maesaroh, Yulita Umilah. 2014. Perbedaan Konsentrasi Ekstrak Daun Pandan Wangi (*Pandanus amaryllifolius* Roxb) Terhadap Kematian Larva Nyamuk *Aedes aegypti*. Karya Tulis Ilmiah Jurusan Kesehatan Lingkungan Poltekkes Bandung.
- Minarni, Emi, dkk. 2013. Daya Larvasida Ekstrak Etil Asetat Daun Kemuning (*Murraya paniculata* (L) Jack) Terhadap Larva Nyamuk *Aedes aegypti*. Jurnal Kedokteran Hewan. Vol. 7, No. 1.
- Notoatmodjo, Soekidjo. 2010. Metodologi Penelitian Kesehatan. Jakarta: Rineka Cipta.
- Nursal dan Etti Sartina Siregar. 2005. Kandungan Senyawa Kimia Ekstrak Daun Lengkuas (*Lactuca Indica* L) Toksisitas dan Pengaruh Subletalnya Terhadap Mortalitas Larva Nyamuk *Aedes aegypti*. Laporan Hasil Penelitian Dosen Muda Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Sumatera Utara. Diakses tanggal 03 Februari 2018. <http://repository.usu.ac.id>.
- Peng, Ching Ching. 2010. Gambaran Pengetahuan Sikap dan Tindakan Masyarakat Kecamatan Pangkalan Kerinci Kabupaten Pelalawan Provinsi Riau tentang Filariasis. Laporan Hasil Penelitian Fakultas Kedokteran Universitas Sumatera Utara Medan. Diakses tanggal 28 Februari 2018. <http://repository.usu.ac.id>.
- Pratiwi, Ameliana. 2013. Studi Deskriptif Penerimaan Masyarakat Terhadap Larvasida Alami. Skripsi Jurusan Ilmu Kesehatan Masyarakat Fakultas Ilmu Keolahragaan. Diakses tanggal 28 Februari 2018.
- Prianto L.A, Juni dkk. 1994. Atlas Parasitologi Kedokteran. Jakarta: Gramedia Pustaka Utama.
- Purba, Dina Mariani. 2010. Isolasi dan Karakterisasi Senyawa Alkaloid Dari Umbi Bawang Sabrang (*Eleutherinae bulbus*). Bahan Skripsi Fakultas Farmasi Universitas Sumatera Utara. Diakses tanggal 28 Februari 2018. <http://repository.usu.ac.id>.
- Sholichah, Zumrotus. 2009. Ancaman dari Nyamuk *Culex* sp yang Terabaikan. BALABA Vol.5, No.01 Juni 2009: 21-23. Staf Loka Litbang P2B2 Banjarnegara. Diakses tanggal 28 Februari 2018.
- Sihombing, Apriani V. 2010. Karakterisasi Simplisia dan Isolasi Serta Analisis Komponen Kimia Minyak Atsiri dari Rimpang Lengkuas Merah (*Galangae rhizoma*) Secara Gc-MS. Skripsi Fakultas Farmasi Universitas Sumatera Utara. Diakses tanggal 28 Februari 2018. <http://repository.usu.ac.id>.
- Suryawati, Ana dkk. 2011. Pengaruh Dosis dan Lama Perendaman Larutan Lengkuas Terhadap Jumlah Bakteri Ikan Bandeng. Vol 7 No. 1.

Yunar, Anggraeni, Wati, Panduwita, Heriyanti

Undang-Undang Republik Indonesia Nomor 36 Tahun 2009 tentang Kesehatan.
Diakses tanggal 06 Januari 2018.