Medico-Legal Update

Editor-in-Chief

Prof. (Dr) R K Sharma
Former Head, Department of Forensic Medicine & Toxicology
All-India Institute of Medical Sciences, New Delhi-110029
E-mail: medicolegalupdate@gmail.com

ASSOCIATE EDITOR
1. S.K. Dhattarwal (Professor) Forensic Medicine, PGIMS, Rohtak, Haryana
2. Dr. Adarsh Kumar (Additional Professor) Forensic Medicine, AIIMS, New Delhi
3. Dr. Vijaynath V (Associate Professor) Forensic Medicine, Vinayaka Mission Medical college, Tamil Nadu
4. Ms. Roma Khan, Forensic Sciences, INSAF Mumbai
5. Dr. Shriro Sabri (Assistant Professor) Department of Bio-Medical Sciences, College of Medicine, King Faisal University, Saudi Arabia

INTERNATIONAL EDITORIAL ADVISORY BOARD
1. B. N. Yadav (Professor) Forensic Medicine, BP Koirala Institute of Medical Sciences, Nepal
2. Dr. Vasudev Murthy Chaklare Ramaswam (Senior Lecturer) Department of Pathology, International Medical University, Bukit Jalil, Kuala Lumpur, Malaysia
3. Babak Mostafazadeh (Associate Professor) Department of Forensic Medicine & Toxicology, Shahid Beheshti University of Medical Sciences, Tehran-Iran
4. Dr. Sarathchandra Kodikara (Lecturer) Forensic Medicine Department of Forensic Medicine, Faculty of Medicine, University of Peradeniya, Sri Lanka

NATIONAL EDITORIAL ADVISORY BOARD
1. Prof. N.K. Agarwal (Professor) Forensic Medicine, UCMS, Delhi
2. P.K. Chattopadhyay, (Professor) Forensic Sciences, Amity University, Noida
3. Dalbir Singh (Professor) Forensic Medicine, PGIMER, Chandigarh
4. Dr. Harish Pathak, Mumbai
5. J. Gargi (Professor) GGS Medical College, Faridkot
6. P.C. Dikshit (Professor) Forensic Medicine, Jamia Hamdard Medical College, New Delhi
7. Anil Mittal (Professor) Forensic Medicine, VMCD, New Delhi
8. Balbir Kaur (Professor) Forensic Medicine, MDU, Rohtak, Haryana
9. Mukesh Yadav (Professor) Forensic Medicine, School of Medical Sciences and Research, Greater Noida
10. T.K.K. Naidu (Professor) Forensic Medicine, Prathima Institute of Medical Sciences, Andhra Pradesh
11. S. Das (Professor) Forensic Medicine, Hindu Mission Institute of Medical Sciences, Dhanbad
12. Col Ravi Rautji, Forensic Medicine, Armed Forces Medical College, Pune
13. Dr. Manish Nigam (Professor and Head) Department of Forensic Medicine and Toxicology, Sri Aurobindo Institute of Medical Sciences, INDORE (M.P.)
14. Dr. Shailesh Kudva (Principal) Rajasthan Dental College and Hospital, Jaipur-302026
15. Usmangani Retar Makandar (Associate Professor) Anatomy, AIIMS, Bhopal
16. Dr. Pratik Patel (Professor and Head) Forensic Medicine, Smt NHL Municipal Medical College Ahmedabad
17. Basappa S. Magar (Associate Professor) Forensic Medicine, Ramalak Medical College, Bangalore

NATIONAL EDITORIAL ADVISORY BOARD
18. Dr. Vandana Mudra (Associate Professor) Dept. of FMT, M.R. Medical College, Gulbarga, Karnataka, India
19. Dr. Harish Kumar N. (Associate Professor) Dept. of Forensic Medicine, Sri Siddhartha Medical College, Turum
20. Dr. Gowri Shankar (Associate Professor) Forensic Medicine, SNMC, Bagalkot
21. Dr. Ramu Neelam Badini (Reader) Dept. of Oral Pathology, Maharana Pratap Dental College and Research Centre, Gwalior
22. Dr. L. Ananda Kumar (Associate Professor) Forensic Medicine, Rajiv Gandhi Institute of Medical Sciences, (RIMS), Kadapa
23. Dr. Ramesh Nanak Wasiak (Associate Professor and Head) Forensic Medicine, Lede B.R.K.M. Govt. Medical college, Jagdalpur
24. Dr. Sachin Sinha (Reader) Dept. of Oral Pathology & Microbiology, Dawson Dental College & Research Centre, Rajasthan
25. Dr. Sashi Kanth, Asst. Professor, A.C.S.R Government Medical College, Nellore, Andhra Pradesh

Medico Legal Update is a scientific journal which brings latest knowledge regarding changing medical legal scenario to its readers. The journal caters to specialties of Forensic Medicine, Forensic Science, DNA fingerprinting, Toxicology, Environmental hazards, Sexual Medicine etc. The journal has been assigned international standard serial number (ISSN) 0971-720X. The journal is registered with Registrar of News Papers for India, vide registration number S975/96 under Press and Publication Act, 1867. The journal is also covered by EBSCO (Excerpta Medica Database) from 1997 and by INDEX COPERNICUS, POLAND. Medico legal update is a half yearly peer reviewed journal. The journal has also been assigned E-ISSN 0973-1283 (Electronic version). The first issue of the journal was published in 1996.

Website: www.medicolegalupdate.org

©All Rights reserved. The views and opinions expressed are of the authors and not of the Medico Legal Update. The Medico Legal Update does not guarantee direct or indirectly the quality or efficacy of any products or service featured in the advertisement in the journal, which are purely commercial.

Editor

Dr. R.K. Sharma
Institute of Medico-Legal Publications
Logix Office Tower, Unit No. 1704, Logix City Centre Mall
Sector-32, Noida - 201 301 (Uttar Pradesh)

Printed, published and owned by

Dr. R.K. Sharma
Institute of Medico-Legal Publications
Logix Office Tower, Unit No. 1704, Logix City Centre Mall
Sector-32, Noida - 201 301 (Uttar Pradesh)

Published at

Institute of Medico-Legal Publications
Logix Office Tower, Unit No. 1704, Logix City Centre Mall
Sector-32, Noida - 201 301 (Uttar Pradesh)
# Medico-Legal Update

## CONTENTS

**Volume 19, Number 1**

January-June 2019

<table>
<thead>
<tr>
<th>Article</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. An Evaluation of Colour Change in Abrasion and its Correlation to Time: A Cross-Sectional Study from a Tertiary Care Centre</td>
<td>1</td>
</tr>
<tr>
<td>Anil Mangeshkar, P S Varghese</td>
<td></td>
</tr>
<tr>
<td>2. Correlation of the Age of Eruption of Teeth with the Body Mass Index among School Children</td>
<td>7</td>
</tr>
<tr>
<td>Karikalan T, Arul R Pandey</td>
<td></td>
</tr>
<tr>
<td>3. Profile of Internal Injuries to Thorax, Abdomen and Pelvis Sustained by the Victim During Fatal Road Traffic Accident in Central India</td>
<td>11</td>
</tr>
<tr>
<td>Manu D Sharma, Deepak L Bhagwat, B. H. Tirpude, P. N. Murkey, I L Khandekar, Sharjeel Khan, Ambedkar Ranjan</td>
<td></td>
</tr>
<tr>
<td>4. Profile of Cases of Fatal Road Traffic Accident with Respect to Diurnal Variation of Time, Age, Sex and Death of Victim in Central Rural India-Autopsy Based Study</td>
<td>15</td>
</tr>
<tr>
<td>Deepak L Bhagwat, Manu D Sharma, B. H. Tirpude, P. N. Murkey, I L Khandekar, Sharjeel Khan, Ambedkar Ranjan</td>
<td></td>
</tr>
<tr>
<td>5. A Two-Year Prospective Study from Punjab Region of India</td>
<td>20</td>
</tr>
<tr>
<td>Mittal D R, Jasbir S, Rai G, Kumar K, Sharma R K</td>
<td></td>
</tr>
<tr>
<td>6. A Prospective Study of Unnatural Deaths in Married Women within Seven Years of Marriage in Hapur District of Western Uttar Pradesh</td>
<td>26</td>
</tr>
<tr>
<td>Rizwi A, Jasbir S, Sharma R K, Abhishek S</td>
<td></td>
</tr>
<tr>
<td>7. Pattern and Distribution of Injuries in Victims of Fatal Road Traffic Accident Cases of Bikers in Haryana a Retrospective Study</td>
<td>31</td>
</tr>
<tr>
<td>Jitender Kumar Jakhau, Tarun Dagan, Naveen Yadav, Piyush Jain</td>
<td></td>
</tr>
<tr>
<td>8. Applicability of Three Component System of Age Estimation in Haryana Population</td>
<td>36</td>
</tr>
<tr>
<td>Kumaran M, Dalbir Singh, Bansal YS, Mandal SP, Murali G</td>
<td></td>
</tr>
<tr>
<td>9. Bite Marks: An Indispensable Tool for Forensic Odontological Evidence</td>
<td>42</td>
</tr>
<tr>
<td>M. K. Sunil, Upender Malik, Sourav Malhotra, Arishah Gulzar, Radhika Sharma</td>
<td></td>
</tr>
<tr>
<td>10. A Study on Pattern of Adolescent Deaths- A Retrospective Study</td>
<td>47</td>
</tr>
<tr>
<td>Santosh Kumar P, Gajanan H Nayak, Mahalakshmi B Karlawad</td>
<td></td>
</tr>
<tr>
<td>11. A Study of Thermal Deaths in Rohtak, Haryana</td>
<td>52</td>
</tr>
<tr>
<td>Malik A K, Sharma D, Dhattarwal S K, Panchal K, Singla K</td>
<td></td>
</tr>
<tr>
<td>12. Does Knowledge and Attitude is Needed Regarding Euthanasia in Clinical Course? A Narrative Review Based on an Available Literature</td>
<td>56</td>
</tr>
<tr>
<td>Mohd. Arif Husain, Ishak Mohammad, Nageshwar V, K M K Sridhar</td>
<td></td>
</tr>
</tbody>
</table>
43. SPEOS (Stimulation of Endorphin, Oxytocin and Suggestive): Intervention to Improvement of Breastfeeding Production ................................................................. 210
   Indah Lestari, Ima Rahimawati, Emik Windarti, Hariyono

44. Natural Insecticide Spray for Aedes sp., Made from Ethanol Extract of Purple Eggplant Fruit (Solanum melongena L.) ........................................................................................................... 216
   Yunan Jiwintarum, Erlin Yustin Tatoonos, Anisa Noviana, Maruni Wiwin Diarti, Setiawan

45. Effect of Vitamin A and Zinc Intake of Breastfeeding Mothers on Infection in Infants ................................................................. 221
   Lydia Fanny, Retno Sri Lestari, Hijrah Asikin

46. Knowledge, Attitudes towards Health Insurance, Eradication of Mosquito Breeding Places and the Incidence of Dengue Hemorrhagic Fever in Badung Regency ................................................................. 225
   I Nyoman Gede Soayasa, Ni Made Sirat, Ni Luh Putu Yuniti Suntari, I Nyoman Wirata

47. The Anachronism of the Indonesian Social Security Policy in Health ........................................................................................................... 229
   Arief Budiono, Absori, Harun, Heru Santoso Wahito Nugroho, Khudziafah Dimyati, Ayesha Hendriana Ngestinigrum, Wafida Vivid Izziyana

48. Effect of Alkali Water Consumption on Decreasing Blood Sugar Levels of Diabetes Mellitus Patients 234
   Dwi Agustanti, Purbianto

49. Family Support for Diabetes Self-care Behavior in T2DM Patients who Use Herbs as a Complementary Treatment ............................................................................ 238
   Anita Joelianita, Manggestuti Agil, M. Bagus Qomaruddin, Kusnanto, Oedojo Soedirham

50. The Influence of Knowledge, Attitude and Action on Family Health Tasks in Controlling Hypertension through the Germs Approach ......................................................................................... 244
   Lembunai Tat Alberta, Dwi Utari Widyastuti

51. Student Centered Learning as a Method to Increase Clinical Competencies of Nursing Students at Health Polytechnic of Jakarta I, Indonesia ........................................................................ 249
   Mumpuni, Uun Nurulhuda, Tutiany, Dewi Purnamawati

52. The Factors Making the Law Protection for the Patients of Esthetic Beauty Clinic in Indonesia not fulfilling Citizen’s Constitutional Right ......................................................................................... 252
   Siska Diana Sari, I Gusti Ayu Ketut Rachmi Handayani, Pujiyono

53. The Application of Cyclone Ventilator Modification for Indoor Air Sanitation ......................................................................................... 257
   Kambali, Setiawan, Kuat Prabowo

54. Efficiency Effort of Inpatient Service for BPJS-Health Participants with Lean Method at Surabaya Islamic Hospital ........................................................................................................... 262
   Muryani, Thiwit Nurul Huda, Yeni Farida, Tito Yustiawan, Setya Haksama, Samsul Ariffin

55. Stirring Chamber Design Development to Increase the Potention of Chicken Egg Shells to Decrease Cadmium (Cd) Level in Blood Cockle (Anadara Granosa) ........................................................................................................... 269
   Narwati, Hadi Suryono

56. Querying the Dataset from the Developed Ontology for Swineflu Disease ................................................................................................. 275
   Radhika Pathi, Suresh Verma Penumatsha, Lakshmi Kalyani Neerukonda, P. Rama Krishna
Natural Insecticide Spray for *Aedes* sp., Made from Ethanol Extract of Purple Eggplant Fruit (*Solanum melongena L.)*

Yunan Jiwintarum¹, Eriel Yustin Tatontos¹, Anisa Noviana¹, Maruni Wiwin Diarti¹, Setiawan²

¹Health Polytechnic of Mataram, Indonesia; ²Health Polytechnic of Surabaya, Indonesia

**ABSTRACT**

Dengue Hemorrhagic Fever (DHF) is an infectious disease caused by the Dengue virus. This virus is transmitted by *Aedes* sp. Many studies have been carried out on the use of plants as biological insecticides, one of which is purple eggplant (*Solanum melongena L*). This study aims to determine whether *Solanum melongena L*. extract spray can be used as an insecticide for *Aedes* sp. This research was a true experimental study, with a sample of 25 *Aedes* sp. 2-5 days old. The treatment given was eggplant extract spray with a concentration of 80%, 60% and 40% then left for 24 hours, with 3 replications. The concentration of 80% ethanol extract caused 84% of the deaths of *Aedes* sp., The concentration of 60% caused 68% of deaths, and a concentration of 40% caused 44% of deaths. The p-value of the probit test was 0.000 (*Solanum melongena L*. ethanol extract in spray form significantly caused the death of *Aedes* sp.) LC₅₀ and LC₉₀ values were at concentrations of 49.124% and 81.343%. Spray of *Solanum melongena L*. ethanol extract can be used as a natural insecticide for *Aedes* sp.

**Keywords:** Ethanol extract, *Solanum melongena L.*, Natural insecticide, *Aedes* sp, Spray

**INTRODUCTION**

DHF is an infectious disease caused by the Dengue virus, which is transmitted through the main vectors, namely the mosquitoes *Aedes aegypti* and *Aedes albopictus*. DHF is spread throughout the tropics including Indonesia. The spread of this disease is influenced by rainfall, temperature, and urbanization⁶. Before 1970, dengue outbreaks occurred in only 9 countries, but subsequently became endemic in more than 100 countries in Africa, America, the Eastern Mediterranean, Southeast Asia and the Western Pacific. The highest rates of DHF occur in America, Southeast Asia and the Western Pacific, with the number of cases > 1.2 million in 2008 > 2.3 million cases in 2010. In 2013 there were 2.35 million cases in America, and 37,687 cases were Severe DHF. From 1968 to 2009, WHO reported that Indonesia was the country with the highest DHF cases in Southeast Asia⁶.

In 2015, the Ministry of Health of the Republic of Indonesia noted that the number of dengue sufferers was 129,650 cases, with the number of deaths being 1,071 (morbidity = 50.75 per 100,000 population and mortality = 0.83%). This number is greater than in 2014, namely 100,347 cases, with morbidity = 39.80⁷. In 2015, the number of dengue cases in NTB province was 1,340, then increased to 3,385 cases, with an increase of 152.61% in 2016. The most cases occurred in Sumbawa, East Lombok and Mataram City. DHF morbidity in NTB in 2016 was 69.10 per 100,000 population. This condition shows an increase compared to 2015, even exceeding the nationally defined limit of <40 / 100,000 population, with the number of cases dying = 32 people⁸.

Indonesia has high air humidity, and this condition triggers the breeding of *Aedes aegypti* and *Aedes albopictus*. *Aedes sp*. is a diurnal animal that starts sucking blood when the sun rises (08.00 - 12.00) until before sunset (15.00 - 17.00). *Aedes aegypti* prefers human blood and is often found indoors, while *Aedes albopictus* prefers animal blood and is usually found outside the home. Population of *Aedes sp*. greatly increased in the rainy season, due to the availability of breeding sites, namely puddles of rain water in used cans, used tires, pieces of bamboo, holes in trees, places to drink birds, etc.⁹.

**Corresponding Author:**

Setiawan
Health Polytechnic of Surabaya, Indonesia
Email: setiawan.jemblung@yahoo.com
Vector control has been carried out both mechanically, biologically and chemically. Vector control is mechanically and biologically friendly to the environment. Mosquito repellent products generally contain high concentrations of synthetic chemicals, which can interfere with human health9, so that there are currently many studies conducted on the use of plants as biological insecticides to minimize negative effects on humans. Biological insecticides have proven potential for controlling vectors, both for eradicating adult larvae and mosquitoes. In addition, these insecticides are biodegradable so they do not pollute the environment, and are relatively safe for nature, humans and livestock, because the residues of these substances quickly disappear.

The power to kill biological insecticides comes from the toxic substances they contain. These substances can be contact poisons, respiratory toxins and stomach poisons in soft-bodied animals9. Biological compounds that have functions as insecticides include saponins, tannins, flavonoids, alkaloids, steroids and essential oils9.

Purple eggplant contains an active substance that can be used as an insecticide, because it contains steroid alkaloids (solasodine, solanine, solanidine), saponins, flavonoids, tannins, coumarin. This fruit skin is rich in anthocyanin and chlorogenic acid7. Saleh (2015) reported that purple eggplant ethanol extract contained flavonoids, tannins, glycosides, steroids and alkaloids. Purple eggplant has better antioxidant activity than 5 other eggplant varieties because it contains high levels of total flavonoids9. The total flavonoid content of purple eggplant ethanol extract was $29.35 \pm 0.09\%$ b/b Equivalent of Quercetin9. Purple eggplant also contains alkaloids $= 0.99 \pm 0.0 mg / 100 g$, tannin $= 11.34 \pm 0.48 mg / 100 g$, and saponin $= 11.63 \pm 0.29 mg / 100 g (11)$. Kandita et al. (2015) reported that leunca fruit had an insecticidal effect on Aedes aegypti with a concentration of 80%. Purple eggplant is one genus with leunca fruit, so it is logical to do research on the utilization of purple eggplant fruit ethanol extract as an insecticide for Aedes sp., Because purple eggplant fruit is easier to obtain in NTB and has high flavonoids9.

**MATERIALS AND METHOD**

The design of this study was Post-Test Only Control Group Design, with 3 treatments and 1 negative control, namely T0: Negative Control (Aquadest); T1: Extract with a concentration of 80%; T2: Extract with a concentration of 60%; T3: Extract with a concentration of 40%. The population of this study were Aedes sp. adults obtained from egg breeding. The sample were 25 Aedes sp. adults 2-5 days for each group, referring to WHO guidelines, using insecticides in the form of spray, with 3 repetitions9. The sample was chosen by purposive sampling technique. The research tools and materials were knives, trays, ovens, blenders, analytic balance, glass jars (simplicia containers), funnels, filter paper, extract storage, aluminum foil, rotary evaporator. The tools used for preparation and maintenance of mosquitoes were black buckets, filter paper, cages, containers (eggs and mosquito larvae), drops of pipettes, aspirators. The tools used for dilution of the test solution were beaker glass, measuring cup, stirring rod, mosquito cage (test barrel) measuring 30 x 30 x 30 cm3, sprayer, label, cotton, paper cup, aspirator, tweezers, tray, basin, observation sheet, purple eggplant fruit, 96% ethanol, water, sugar solution, fish pellets, Aedes sp. adult.

The preparation stage was preparing the eggs of Aedes sp; making ovitrap using black bucket 3; insert clean water up to ¾ bucket; put filter paper on the bucket wall; put the ovitrap in dark places and leave it for 5-7 days. Filter paper containing eggs was removed and then dried.

The maintenance phase of Aedes sp was soaking filter paper in a container filled with water; leave it for 1-2 days until the eggs hatch, then become larvae. Larvae develop from stage I to IV within 5 days. The larvae turn into pupae; then transferred to the cup. Each cup contains 30 pupae, then the cup was moved into the barrel, each barrel contains 2 cups. During its development period, pupae which had become adult mosquitoes were fed with a 10% sugar solution on cotton.

Making ethanol extract of purple eggplant fruit was washing purple eggplant, then slicing it thinly, then putting it in the oven at 40°C for 24 hours. The dried fruit is mashed using a fine mesh, then dissolved in 96% ethanol with a ratio of 1:5; then taken 200 grams then added to 1000 ml of 96% ethanol. The maceration container is closed and then stored for 3 x 24 hours in a place protected from direct sunlight, then stirred every 5 minutes. After leaching, then filtered, then the extract is separated from the pulp. Ethanol was evaporated using a rotary evaporator at 40°C, so that 100% extract was obtained9.
Making variations in extract concentration was: making a solution of purple eggplant ethanol extract with a concentration of 80%, 60%, and 40% from the solution of 100% purple eggplant ethanol extract using a dilution formula:

The 1 time spray weight

\[
\frac{(A - B) + (B - C) + (C - D) \times \text{3 replicants} \times \text{10 sprays}}{	ext{Amount of spray needed is calculated by the formula:}}
\]

\[
\frac{\text{Standard does (0.70 grams) **}}{\text{The 1 time spray weight}}
\]

Note:

*The difference between each test must be <0.20 grams

**Standard dosage used at UPKV/USM Malaysia[10].

The testing stage was to prepare 4 barrels of square test (30 cm³) and 4 spray bottles containing a solution of ethanol extract of purple eggplant fruit. Prepare 10% sugar solution for each barrel. Move 25 Aedes sp. to each barrel. Spray the extract solution with a certain concentration into each barrel, on the barrel wall. Barrel 1 is sprayed using aquaest, a maximum of 10 sprays; 2-4 test barrels were sprayed using extracts with concentrations of 80%, 60% and 40%; then let stand for 24 hours, then the number of dead mosquitoes was calculated and recorded. If the number of mosquito deaths in the negative control group was <5%, it could be ignored; but if > 80%, then the test must be repeated. If the mortality of mosquitoes in the negative control group was 5%~80%, then the percentage of mosquito deaths in each dose was calculated using the Abbot formula:

\[
\text{Percentage of deaths in the treatment group} = \frac{\text{Percentage of deaths in the control group} \times 100}{100 - \text{Percentage of deaths in the control group}}
\]

The data analysis stage was using a probit test with a confidence level of 95%, to prove the effect of giving purple eggplant ethanol extract and Lethal Concentration value (LC₉₅ and LC₉₀).

**FINDINGS**

Insecticide test results of purple eggplant fruit extract against Aedes sp. can be seen in table 1.

**Table 1: Death of Aedes sp.**

<table>
<thead>
<tr>
<th>Extract concentration</th>
<th>Number of Aedes sp.</th>
<th>Aedes sp. Deaths (replication)</th>
<th>Mean</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>80%</td>
<td>25</td>
<td>22</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>60%</td>
<td>25</td>
<td>17</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>40%</td>
<td>25</td>
<td>11</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Negative control</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 1 shows that the number of deaths of Aedes sp. the highest was at a concentration of 80%, followed by a concentration of 60%, 40% and control with the number of deaths = 0.

The relationship between the percentage of mosquito deaths with extract concentrations is shown in Figure 1.
Figure 1 shows that the percentage of mosquito deaths was directly proportional to concentration.

Effect of purple eggplant extract on the death of *Aedes sp.* can be seen in tables 2 and 3.

**Table 2: Parameter estimates**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>Std. Error</th>
<th>Z</th>
<th>Sig.</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROBIT</td>
<td>Concentration</td>
<td>0.040</td>
<td>0.004</td>
<td>9.457</td>
<td>0.000</td>
<td>0.032</td>
</tr>
</tbody>
</table>

Table 2 shows the p-value of the Probit test was 0.000 (purple eggplant extract caused the death of *Aedes sp.* significantly).

**Table 3: Chi-square test**

<table>
<thead>
<tr>
<th>PROBIT</th>
<th>Pearson Goodness-of-Fit Test</th>
<th>Chi-Square</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.327</td>
<td>10</td>
<td></td>
<td>0.868</td>
</tr>
</tbody>
</table>

Table 3 shows that Pearson goodness-of-fit-test was 0.868 (> 0.500), so it was interpreted that the relationship between extract concentration and mosquito mortality was directly proportional.

The values of *LC*$_{50}$ and *LC*$_{90}$ are presented in table 4.

**Table 4: Nilai LC*$_{50}$ dan LC*$_{90}$**

<table>
<thead>
<tr>
<th>LC</th>
<th>Estimate</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower</td>
<td>Upper</td>
</tr>
<tr>
<td>PROBIT</td>
<td>50</td>
<td>49.124</td>
<td>44.431</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>81.343</td>
<td>75.029</td>
</tr>
</tbody>
</table>

Table 4 shows that extract concentrations caused 50% of the deaths of *Aedes sp.* was 49.124%, while the concentration of extract which caused 90% of deaths was 81.343%.

**DISCUSSION**

Eggplant powder was extracted by maceration method using 96% ethanol. The maceration method is chosen because it is a simple method of retrieval. The use of 96% ethanol aims to attract active substances namely flavonoids, glycaalkaid, saponins and tannins which are thought to have an insecticidal effect on *Aedes sp.* 96% ethanol is semipolar so it can dissolve polar and non-polar chemicals.

*Aedes sp.* in this study was 2-5 days old. The age of mosquitoes is a factor that greatly influences the resistance of mosquitoes to exposure to chemical compounds, so the age of mosquitoes is important. Referring to WHO insecticide test guidelines, 2-5 days is the best age, with good and productive body resistance.

The results showed that the higher the concentration of purple eggplant extract given, the higher the percentage of death of *Aedes sp.* with *LC*$_{50}$ and *LC*$_{90}$ being 49.124% and 81.343%, respectively. Similar reports were submitted by Kandiht et al. (2015) that leunca fruit extract (one genus with purple eggplant) has an insecticidal effect on *Aedes aegypti* with a concentration of 80%.

Musdalifah (2016) reported that the average mortality of mosquitoes given lime peel extract with a concentration of 15% was 25%, with a concentration of 30% was 45% mortality, and with a concentration of 60% was 62% death. These results are similar to the results of this study, that the percentage of mosquito deaths is directly proportional to the concentration of extracts of biological materials used. The higher the concentration used, the higher the active ingredient in the extract. The toxic power caused by purple eggplant extract is caused by the presence of active ingredients contained in the extract. Some bioactive compounds that are thought to be contained in purple eggplant extract include flavonoids, saponins, glycaalkaid and tannins which have proven to be contact poison and respiratory toxins in insects, especially *Aedes sp.*

As a phenol, flavonoids attack the nerves in some vital organs of insects, causing nerve weakness, such as respiratory problems and death. As terpenoids,
saponins can bind to free sterols in the digestive tract of mosquitoes, where sterols are precursors of the hormone ecdision, so that if the number of free sterols decreases, there will be disruption of moulding of insects. Saponins can also destroy red blood grains and are toxic to cold blooded animals (6). Glycolkaldoid functions as a contact poison for Aedes sp. The ability of the glycosalkaldoid to bind the $3\beta$-hydroxy sterol membrane can interfere with membrane function. This substance also inhibits the action of the acetylcholinesterase enzyme, giving rise to the accumulation of acetylcholine in the nervous system, which in turn causes digestive defects, nervous disorders and death\(^{(18)}\).

Utilization of biological compounds is relatively safe for the environment and humans, because it is easily biodegradable so that the residue quickly disappears. In general, the function and effectiveness of insecticides is directly proportional, meaning that the higher the dose of insecticide, the higher the chance to control insects. Even though there are no studies that directly explain the effects of using natural insecticides on human health, its application in the environment must remain under control. For now, the use of natural insecticides is an alternative to controlling insects in households safely, and helps minimize the risk of environmental damage.

**CONCLUSION**

Based on the results of the study it can be concluded that purple eggplant fruit extract is effective as an insecticide for Aedes sp.

**Conflict of Interest:** This research is free from conflict of interest

**Ethical Clearance:** This study has been equipped with a certificate of ethical clearance from the health research ethics committee

**Source of Fundings:** The authors are funders of this study

**REFERENCES**


