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The Effectiveness of Butterfly Pea (*Clitoria ternatea* L.) and Golden Trumpet (*Allamanda cathartica*) Flower as Natural Larvicides Against *Aedes aegypti*

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Abstract
Introduction: *Aedes aegypti is a major dengue vector, requiring alternative plant-based larvicides.* ***Objective:*** *This study compared the larvicidal effectiveness of butterfly pea (Clitoria ternatea L.) and golden trumpet (Allamanda cathartica) flower extracts against Aedes aegypti larvae.* ***Method:*** *A true experimental study with a completely randomized design (CRD) was conducted using butterfly pea and golden trumpet flower extracts prepared by maceration with distilled water at concentrations of 15%, 25%, 35%, and 45%, with three replications per treatment. Twenty-five third- to fourth-instar Aedes aegypti larvae were exposed to each treatment, and mortality was assessed after 24 hours. Data were analyzed using the Kruskal-Wallis and Mann-Whitney tests.* ***Results and Discussion:*** *Butterfly pea extract produced mortality of 38%, 58%, 50%, and 61%, while golden trumpet extract produced 17%, 34%, 37%, and 46%, respectively. Butterfly pea showed higher mortality at all concentrations. The Kruskal-Wallis test showed significant differences among concentrations for both extracts (p = 0.018 and p = 0.010). However, the Mann-Whitney test showed a significant difference between extracts only at 25% concentration (p = 0.043).* ***Conclusion:*** *Both extracts exhibited larvicidal activity, with butterfly pea showing higher effectiveness descriptively.*

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Introduction

Dengue remains an important vector-borne disease in tropical and subtropical regions, including Indonesia. *Aedes aegypti* is the primary vector responsible for dengue transmission and is well adapted to tropical environmental conditions. The presence of suitable breeding sites, population density, and human mobility contributes to the persistence and transmission of dengue in communities (Efriza & Putra, 2023; Yasobant et al., 2020). In Indonesia, dengue cases have fluctuated in recent years, with a substantial increase reported in 2024, indicating that vector control remains an important public health concern (Kemenkes, 2024). Dengue vector control can be conducted through environmental management, mosquito breeding-site elimination, and the use of larvicides. The 3M Plus strategy is promoted to reduce mosquito breeding sites, while larvicides can be used to control mosquitoes at the larval stage before they develop into adults (Kandi et al., 2023; Kemenkes RI, 2023). Chemical larvicides such as temephos have been widely used because of their effectiveness. However, prolonged and inappropriate insecticide use may contribute to insecticide resistance and may cause environmental contamination and adverse effects on non-target organisms (Anggraini et al., 2022; Kandi et al., 2023). These limitations highlight the need for alternative larvicides that are potentially safer and more environmentally sustainable. Plant-based larvicides are considered promising because plants contain secondary metabolites with biological activity against insects (Alkausyari Aziz et al., 2025).

Butterfly pea (*Clitoria ternatea* L.) is one plant with potential as a natural larvicide. Its flowers contain secondary metabolites, including flavonoids, tannins, saponins, steroids, and triterpenoids (Yuliasari et al., 2023). These compounds may interfere with larval physiological processes, including the nervous, respiratory, digestive, and cellular systems, thereby contributing to larval mortality (Permana et al., 2022). Previous research demonstrated that butterfly pea flower extract had larvicidal activity against *Aedes albopictus* larvae, with mortality increasing at higher extract concentrations (Lukiyono et al., 2023). These findings indicate the potential of butterfly pea as a plant-based larvicide, although its effectiveness against *Aedes aegypti* requires further investigation.

Another plant with potential larvicidal activity is golden trumpet (*Allamanda cathartica*). This plant contains various secondary metabolites, including flavonoids, phenolic compounds, alkaloids, saponins, tannins, steroids, terpenoids, and volatile compounds, which are associated with biological and insecticidal activities (Petricevich & Abarca-Vargas, 2019). Previous research showed that *Allamanda cathartica* leaf extract increased mortality of *Aedes aegypti* larvae, with higher concentrations producing greater mortality after exposure (Rahmaningtyas et al., 2023). However, the previous study used the leaves rather than the flowers, leaving the potential larvicidal activity of the flowers insufficiently explored. Previous studies have generally evaluated butterfly pea or *Allamanda cathartica* separately and used different mosquito species or plant parts. Butterfly pea flower extract has been investigated against *Aedes albopictus*, whereas *Allamanda cathartica* has been investigated using its leaves against *Aedes aegypti* (Lukiyono et al., 2023; Rahmaningtyas et al., 2023). Therefore, a direct comparison of butterfly pea and golden trumpet flower extracts against the same target species, *Aedes aegypti*, is needed. This study aimed to compare the larvicidal effectiveness of butterfly pea (*Clitoria ternatea* L.) and golden trumpet (*Allamanda cathartica*) flower extracts against *Aedes aegypti* larvae at concentrations of 15%, 25%, 35%, and 45%.

Method

This study used a true experimental design with a completely randomized design (CRD). The experimental treatments consisted of butterfly pea (*Clitoria ternatea* L.) and golden trumpet (*Allamanda cathartica*) flower extracts at concentrations of 15%, 25%, 35%, and 45%, with three replications for each treatment. The test organisms were third- to fourth-instar *Aedes aegypti* larvae obtained from the Surabaya Center for Public Health Laboratory.

A total of 500 g of dried flower material from each plant, butterfly pea (*Clitoria ternatea* L.) and golden trumpet (*Allamanda cathartica*), was used for extraction. The plant materials were cleaned to remove impurities and ground into powder. Each plant material was extracted separately using the maceration method with distilled water as the solvent at a material-to-solvent ratio of 1:10. Thus, 500 g of powdered flower material from each plant was macerated with 5,000 mL of distilled water. The maceration process was conducted for 2 × 24 hours. After maceration, the extract was filtered to separate the liquid extract from the plant residue. The filtrate was subsequently concentrated using a rotary evaporator to obtain the concentrated flower extract used in the larvicidal assay.

The concentrated flower extracts were prepared at concentrations of 15%, 25%, 35%, and 45%. For each 100 mL of test solution, 15 mL, 25 mL, 35 mL, and 45 mL of the respective flower extract were measured for the 15%, 25%, 35%, and 45% concentrations, respectively, and diluted with distilled water to a final volume of 100 mL. The larvicidal test was conducted using glass containers containing 100 mL of the respective test solution. Each container contained 25 third- to fourth-instar *Aedes aegypti* larvae. Each treatment was replicated three times, with each container considered one experimental unit. Distilled water was used as the negative control, while Abate was used as the positive control. The positive control solution was prepared by dissolving 1 g of Abate in 100 mL of distilled water.

The experimental containers were maintained under the same laboratory conditions throughout the 24-hour observation period. The temperature of the test medium was measured before larval introduction and ranged from approximately 25.0–26.6°C. Larval mortality was observed after 24 hours of exposure. Larvae were considered dead when they showed no movement or response to stimulation. The percentage of larval mortality was calculated based on the number of dead larvae relative to the total number of larvae in each experimental unit. Larval mortality data were analyzed descriptively based on the percentage of dead larvae after 24 hours of exposure. The Kruskal-Wallis test was used to compare larval mortality among concentrations within each flower extract. Pairwise comparisons were subsequently performed using the Mann-Whitney test. The Mann-Whitney test was also used to compare larval mortality between butterfly pea and golden trumpet extracts at each concentration. Statistical significance was determined at $p < 0.05$.

Research and Discussions

1. Result

After 24 hours of exposure, both flower extracts showed larvicidal activity against *Aedes aegypti* larvae. Butterfly pea (*Clitoria ternatea* L.) extract produced mortality rates of 38%, 58%, 50%, and 61% at concentrations of 15%, 25%, 35%, and 45%, respectively. Golden trumpet (*Allamanda cathartica*) extract produced mortality rates of 17%, 34%, 37%, and 46%, respectively. The negative control showed 0% mortality, while the positive control showed 100% mortality.

Table 1
Larval Mortality of Aedes aegypti After 24 Hours

Extract	Concentrations			
	15%	**25%**	**35%**	**45%**
Negative control	0%	0%	0%	0%
Positive control	100%	100%	100%	100%
Butterfly pea	38%	58%	50%	61%
Golden Trumpet	17%	34%	37%	46%

Source: *Primary Data 2026*

As shown in Table 1, butterfly pea extract produced higher mortality than golden trumpet extract at all tested concentrations. The highest mortality was observed at 45% concentration for both extracts, with 61% mortality for butterfly pea and 46% for golden trumpet. The two extracts showed different mortality patterns across concentrations. Butterfly pea extract showed a non-monotonic pattern, with mortality increasing from 38% at 15% concentration to 58% at 25%, decreasing to 50% at 35%, and increasing again to 61% at 45%. In contrast, golden trumpet extract showed a progressive increase in mortality from 17% at 15% concentration to 34%, 37%, and 46% at 25%, 35%, and 45%, respectively.

The Kruskal-Wallis test showed significant differences among treatment concentrations for both butterfly pea extract ($p = 0.018$) and golden trumpet extract ($p = 0.010$). Mann-Whitney analysis was performed to compare larval mortality between the two extracts at each concentration. A significant difference was found only at 25% concentration ($p = 0.043$), while no significant differences were observed at 15% ($p = 0.050$), 35% ($p = 0.275$), and 45% ($p = 0.513$).

Table 2
Comparison of Larval Mortality Between Extracts

Concentration	Butterfly pea	Golden trumpet	p-value
15%	38%	17%	0.050
25%	58%	34%	0.043
35%	50%	37%	0.275
45%	61%	46%	0.513

Significant at $p < 0.05$. Source: *Primary Data 2026*

Based on Table 2, the Mann-Whitney test showed a p-value of 0.050 at 15% concentration and 0.043 at 25% concentration. At 35% and 45% concentrations, the p-values were 0.275 and 0.513, respectively. Using a significance level of $p < 0.05$, only the 25% concentration showed a statistically significant difference between butterfly pea and golden trumpet extracts. At 15%, 35%, and 45% concentrations, no statistically significant differences were observed.

2. Discussion

The results showed that both butterfly pea (*Clitoria ternatea* L.) and golden trumpet (*Allamanda cathartica*) flower extracts demonstrated larvicidal activity against *Aedes aegypti* larvae, as indicated by mortality observed after 24 hours of exposure. Butterfly pea extract produced mortality rates of 38%, 58%, 50%, and 61%, whereas golden trumpet extract produced mortality rates of 17%, 34%, 37%, and 46% at concentrations of 15%, 25%, 35%, and 45%, respectively. Thus, butterfly pea produced higher observed larval mortality than golden trumpet at every concentration tested.

Butterfly Pea Extract

Butterfly pea (*Clitoria ternatea* L.) extract demonstrated larvicidal activity against *Aedes aegypti* larvae, with mortality rates of 38%, 58%, 50%, and 61% at concentrations of 15%, 25%, 35%, and 45%, respectively. The highest observed mortality was 61% at 45% concentration. The larvicidal activity may be associated with secondary metabolites present in butterfly pea, including flavonoids, saponins, tannins, alkaloids, steroids, and triterpenoids (Yuliasari et al., 2023). These compounds may contribute to larval mortality through interference with physiological processes, including nervous and digestive functions (Ekayani et al., 2021). The mortality response of butterfly pea showed a non-monotonic concentration-response pattern, as mortality increased from 38% at 15% to 58% at 25%, decreased to 50% at 35%, and increased again to 61% at 45%. Thus, increasing the extract concentration did not consistently result in an increase in larval mortality. The decrease at 35% should be interpreted cautiously because the present study did not specifically investigate the mechanism responsible for this variation. Differences in larval susceptibility and other experimental factors may contribute to variation in mortality between treatment groups. The Kruskal-Wallis test showed an overall significant difference among the butterfly pea concentration groups (p = 0.018), but the pairwise Mann-Whitney comparisons did not show significant differences between the concentration groups. Therefore, the decrease observed at 35% should not be interpreted as evidence that the higher concentration reduced larvicidal activity, but rather as a variation in the observed concentration-response pattern. Factors such as larval condition, exposure conditions, and differences in the amount or composition of bioactive compounds obtained during extraction may also influence larval mortality (Noya et al., 2022; Sasadara & Wiranata, 2022).

These findings are consistent with previous studies reporting larvicidal activity of butterfly pea. Lukiyono et al. (2023) reported an LC_{50} of 39.815% for butterfly pea flower extract against third-instar *Aedes albopictus* larvae, while Rizkawati et al. (2026) also reported larvicidal activity of butterfly pea flower infusion against *Aedes aegypti*. Differences in mortality patterns between studies may be related to differences in plant material, extraction methods, solvents, concentrations, mosquito species, and experimental conditions. Therefore, the present findings demonstrate larvicidal activity of butterfly pea, with 45% producing the highest observed mortality, but they do not establish that 45% represents an effective larvicide in a broader statistical or efficacy sense.

Golden Trumpet Extract

Golden trumpet (*Allamanda cathartica*) extract also demonstrated larvicidal activity against *Aedes aegypti* larvae, with mortality rates of 17%, 34%, 37%, and 46% at concentrations of 15%, 25%, 35%, and 45%, respectively. Unlike butterfly pea, the mortality response showed a more consistent increase with increasing concentration, with the highest observed mortality of 46% at 45%. The larvicidal activity may be associated with secondary metabolites such as flavonoids, saponins, alkaloids, and tannins (Rahmaningtyas et al., 2023), which may contribute to larval mortality through disruption of physiological processes. The increasing mortality observed with golden trumpet indicates a concentration-related observed larvicidal response within the tested concentration range. However, this descriptive pattern does not mean that every increase in concentration produced a statistically significant increase in mortality. The Kruskal-Wallis test showed a significant difference among the treatment groups (p = 0.010), while the Mann-Whitney analysis showed a significant difference only between the 15% and 25% concentrations (p = 0.046). Thus, although mortality increased from 17% to 46% as concentration increased, the statistical evidence did not demonstrate significant differences between all concentration levels. At the highest concentration tested, mortality remained below 50%, indicating larvicidal activity but not sufficient evidence to classify the extract as an effective larvicide across the tested concentration range.

The findings are consistent with Rasjid et al. (2024), who reported larvicidal activity of *A. cathartica* extract against *Aedes aegypti*. However, the mortality rates reported in that study were lower than those observed in the present study. In contrast, Salnus (2026) reported 100% mortality at a 35% concentration using ethanolic leaf extract, with an estimated LC_{50} of 23.72%. Differences between studies may be related to differences in plant part, extraction method, solvent, concentration, and experimental conditions. In particular, the present study used flower material and distilled water, whereas Salnus (2026) used leaves and ethanol. Such differences may affect the amount and composition of bioactive compounds obtained and consequently influence larvicidal activity (Sasadara & Wiranata, 2022).

Comparison of Butterfly Pea and Golden Trumpet Extracts

The comparison showed that butterfly pea (*Clitoria ternatea* L.) extract produced higher observed larval mortality than golden trumpet (*Allamanda cathartica*) extract at all tested concentrations. Mortality rates for butterfly pea were 38%, 58%, 50%, and 61% at concentrations of 15%, 25%, 35%, and 45%, respectively, compared with 17%, 34%, 37%, and 46% for golden trumpet. However, the Mann–Whitney test showed a statistically significant difference between the two extracts only at the 25% concentration (p = 0.043). At 15%, 35%, and 45%, the differences were not statistically significant (p = 0.050, 0.275, and 0.513, respectively). Thus, although butterfly pea showed higher observed mortality across all concentrations, a statistically significant difference between the two extracts was demonstrated only at 25%.

The difference in larvicidal activity between the two extracts may be related to differences in the composition and amount of secondary metabolites present in each plant. Butterfly pea contains secondary metabolites such as flavonoids, saponins, tannins, alkaloids, steroids, and triterpenoids, which have been associated with larvicidal activity (Yuliasari et al., 2023). Golden trumpet also contains secondary metabolites, including flavonoids, saponins, alkaloids, and tannins, which may contribute to its larvicidal activity (Rahmaningtyas et al., 2023). Differences in the composition of these compounds, as well as extraction methods and solvents, may influence the amount of bioactive compounds obtained and consequently affect larval mortality (Sasadara & Wiranata, 2022).

The findings are consistent with previous studies reporting larvicidal activity of butterfly pea and golden trumpet. Lukiyono et al. (2023) reported an LC_{50} of 39.815% for butterfly pea flower extract against third-instar *Aedes albopictus*, while Rizkawati et al. (2026) reported larvicidal activity of butterfly pea flower infusion against *Aedes aegypti*. For golden trumpet, Rasjid et al. (2024) also reported larvicidal activity against *Aedes aegypti*. Differences in mortality between studies may be related to differences in plant material, extraction methods, solvents, concentrations, and experimental conditions. Overall, both extracts demonstrated larvicidal activity against *Aedes aegypti*, with butterfly pea producing higher observed mortality at all tested concentrations. However, the present findings do not demonstrate that butterfly pea was statistically more effective than golden trumpet at all concentrations, because a significant difference was observed only at 25%. Therefore, the mortality percentages describe the observed larvicidal activity of each extract, while the Mann–Whitney test determines whether the difference between the extracts at the same concentration is statistically significant.

Conclusion

Both butterfly pea (*Clitoria ternatea* L.) and golden trumpet (*Allamanda cathartica*) flower extracts demonstrated larvicidal activity against *Aedes aegypti* larvae. Butterfly pea extract showed higher mortality descriptively at all tested concentrations, with the highest mortality of 61% at 45%, while golden trumpet extract produced the highest mortality of 46% at 45%. The statistical comparison showed a significant difference between the two extracts only at the 25% concentration ($p = 0.043$). Thus, butterfly pea extract showed greater larvicidal effectiveness descriptively than golden trumpet extract, although the difference was not statistically significant at all concentrations.

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