4.2 Determination of lethal concentrations (LC50, LC90)

Lethal concentration values such as LC50 and LC90 are critical metrics for quantifying the potency of plant extracts against mosquito larvae. The ethyl acetate fraction of *Croton macrostachyus* exhibited an LC50 of 38.60 ppm and an LC90 of approximately 100 ppm against *Anopheles gambiae* larvae, indicating high efficacy compared to other tested plants (Tadesse et al., 2025). Hexane extracts from *Abutilon bidentatum* also demonstrated potent larvicidal activity with an LC50 value of 40.77 ppm and an LC90 value near 100.54 ppm under semi-field conditions (Muhammed et al., 2024).

In addition, hexane extracts of *Lantana camara* showed remarkable toxicity with an LC50 value as low as 20.19 ppm and an LC90 around 49.29 ppm against local strains of *Anopheles gambiae* larvae (Wangrawa et al., 2016). These quantitative assessments provide essential benchmarks for comparing bioactivity across different plant species and extraction solvents, guiding selection for further development as biopesticides.

4.3 Analysis of time-dose response relationships

Time-dose response studies reveal that both exposure duration and extract concentration significantly influence larval mortality outcomes. For example, methanol extracts from *Momordica foetida*, *Gnidia glauca*, and *Vepris soyauxii* showed increasing mortality rates over time, with LC50 values decreasing after 48 hours compared to 24-hour exposures, indicating enhanced toxicity with prolonged contact (Njuabe et al., 2022). This temporal effect is important for understanding how quickly plant-based larvicides act in practical settings.

Similarly, ethanol extracts from several plants demonstrated higher larval mortality after extended exposure periods; *Jatropha curcas* and *Ricinus communis* ethanol extracts reached near-complete mortality only after 48 hours at high concentrations (1000 ppm) (Okbatinsae and Haile, 2017). These findings highlight the necessity to consider both dose and exposure time when evaluating the effectiveness of plant-derived larvicides to optimize their use in integrated vector management strategies.

5 Effects of Plant Extracts on Adult Mosquitoes

5.1 Evaluation of contact toxicity and repellency

Plant extracts have demonstrated significant contact toxicity against adult *Anopheles gambiae* mosquitoes, with some extracts achieving high mortality rates at relatively low concentrations. For example, methanol crude extracts of *Croton macrostachyus* showed strong adulticidal activity, reaching 100% mortality at 400 ppm and exhibiting LC50 and LC90 values of 55.32 ppm and 86.77 ppm, respectively (Tadesse et al., 2025). Similarly, essential oils from plants such as *Cymbopogon winterianus*, *Cinnamomum zeylanicum*, and *Thymus vulgaris* exhibited combined repellent, irritant, and toxic effects on adult mosquitoes, suggesting multiple modes of action that could reduce mosquito-human contact effectively (Delétré et al., 2013).

Repellency studies further support the potential of plant extracts as alternatives to synthetic insecticides. Extracts from *Eclipta alba* and *Andrographis paniculata* provided dose-dependent protection against mosquito bites without causing allergic reactions in human subjects, indicating their suitability for topical application (Govindarajan and Sivakumar, 2011). Additionally, ethanolic extracts of *Cymbopogon citratus* and *Ocimum basilicum* leaves showed effective repellency against *Culex quinquefasciatus* adults, with *Cymbopogon citratus* demonstrating superior efficacy (Aïzoun et al., 2025). These findings highlight the dual utility of plant extracts in both killing and deterring adult mosquitoes.

5.2 Effects on adult survival rate and longevity

Exposure to certain plant extracts significantly reduces the survival rate and longevity of adult Anopheles mosquitoes. For instance, aqueous leaf extracts of *Zehneria scabra* caused notable adult mortality with an LC50 value of 176.20 ppm against *Anopheles stephensi* adults after 24 hours exposure (Muhammed et al., 2022). Similarly, methanol extracts of *Azadirachta indica* achieved 75% adult mortality at 300 ppm against Anopheles arabiensis, indicating substantial impact on adult survival (Ejeta et al., 2021). These reductions in lifespan can decrease the likelihood of disease transmission by shortening the period during which mosquitoes remain infectious.