EVALUATING THE TOXICITY OF SELECTED PHYTOEXTRACTS IN COMPARISON WITH INSECTICIDES AGAINST HOUSE CRICKET (*ACHETA DOMESTICUS*) UNDER CONTROLLED CONDITION

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Abstract

House cricket, *Acheta domesticus* (Orthoptera: Gryllidae) is a significant domestic insect nuisance worldwide. Crickets are considered pests because they consume the fabric and fibers of clothes and carpets, resulting in damage and roughening the surface. The purpose of this study was to investigate the effect of botanical extracts in comparison with insecticides on house cricket (*A. domesticus*). Five different concentrations of botanical extracts *Ricius communis* (castor), *Moringa oleifera* (moringa), and *Azadirachta indica* (neem), alongside insecticides cypermethrin, deltamethrin were used on filter paper in petri dishes and allowed to air dry at room temperature for 5 minutes. The 20 adult house crickets were released on treated filter paper in each petri dish. To acquire reliable findings, the procedures were replicated three times and one control. Mortality data was recorded after 24, 48, 72, and 96 hours and a comparison of the mean of each treatment was compared using the ANOVA technique under a completely randomized design (CRD). Tukey HSD test was used for means of significant treatment at 5%. In this study, cypermethrin has the highest mortality 81.67% followed by deltamethrin 76.67%, *A. indica* 75%, *R. communis* at 68.33% and *M. oleifera* extract has the lowest mortality 58.33% after 96 hours of treatment. Cypermethrin had the highest mortality rate, hence it was proven to be most effective against house cricket.

Keywords: Pest management, House crickets, Damage, Botanical Extracts, Insecticides.

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1. INTRODUCTION

House crickets, scientifically known as *Acheta domesticus*, are small insects that have adapted to thrive near human habitats. House crickets are native to southwestern Asia but have been widely distributed by humans (Pilco-Romero et al., 2023; Vaga et al., 2021). They belong to the Gryllidae family, these insects are characterized by their distinctive chirping sounds, produced primarily by male crickets to attract females (Ren et al., 2023). The resilient nature of house crickets, their ability to reproduce rapidly, and their preference for warm and dark environments make them persistent pests (Takacs et al., 2023).

House crickets pose a significant threat to crops, particularly cotton. Their voracious appetite and feeding habits can result in substantial economic losses for cotton farmers (Fernandez-Cassi et al., 2018). The damage caused by crickets to cotton crops not only affects the yield but also has broader implications for the textile industry and the economy at large (Ngóngá et al., 2021). Although house crickets do not pose direct health threats, they can indirectly impact human well-being. The droppings and exoskeletons of crickets can trigger allergies and respiratory issues in sensitive individuals (Fukutomi and Kawakami, 2021; Linares et al., 2008).

To address the challenges posed by house crickets, various pest management methods are employed. Chemical insecticides have been conventionally used for their rapid and efficient action against a wide range of insects (Zowada et al., 2020). However, the environmental impact and potential harm to non-target species have raised concerns, prompting the exploration of alternative approaches (Malhotra et al., 2021). Botanical extracts, derived from plants offer a promising avenue for eco-friendly pest management (Divekar, 2023).

Cypermethrin and Deltamethrin, both of the pyrethroid insecticides, are widely used for their rapid knockdown effect on insects (Dong et al., 2016). These chemicals act on the nervous system of pests, leading to paralysis and eventual death (Özdemir et al., 2018). However, their non-selective nature raises concerns about adverse effects on beneficial insects, aquatic organisms, and even human health (Sinha and Shrivastava, 2018). The potential environmental contamination and negative impact on non-target species highlight the need for a balanced and sustainable approach to pest management (Mishra et al., 2021).

Moringa oleifera, known as the drumstick tree, possesses insecticidal properties attributed to compounds like isothiocyanates and alkaloids (Joshi et al., 2016). *Ricinus communis*, the castor plant, contains ricin and ricinine, which have demonstrated insecticidal effects (Sotelo-Leyva et al., 2020). *Azadirachta indica*, commonly known as neem, is renowned for its insect-repelling properties due to azadirachtin and other active compounds (Kilani-Morakchi et al., 2021). These botanical extracts interfere with insect physiology, disrupting vital processes and providing a natural means of pest control (Kaur et al., 2023). The significance of these phytoextracts lies in their potential to offer effective alternatives to traditional chemical insecticides while minimizing environmental impact (Akram et al., 2022).

This research aims to bridge the gap between conventional chemical insecticides and botanical extracts in managing house cricket populations. By evaluating the toxicity of selected phytoextracts in comparison with established insecticides, the study aims to provide insights into effective, environmentally sustainable pest control methods. The significance of this research lies in its potential to contribute to developing integrated pest management strategies, promoting a holistic approach that balances efficacy, environmental impact, and human health considerations. The findings could have broad applications in agricultural practices, and pest control industries, and contribute to the ongoing efforts for more sustainable and ecologically responsible pest management solutions.

2. MATERIALS AND METHODS

2.1 Collection of house cricket

House crickets were collected from a mud-making house in the village area of District Toba Tek Singh. For rearing and bioassay studies house crickets were brought in a laboratory at the Department of Entomology, University of Agriculture, Faisalabad.

2.2 Rearing of house cricket

House crickets were collected from different locations and cultured in a container at room temperature. The large container contained two small containers where the relative humidity was 70 percent. These two small containers were used for breeding. Coconut fabric was applied for oviposition. Egg trays were used in the large container for hiding the adult house cricket. A large container was cleaned after 1.5 months to remove the feces of the house cricket. Different vegetables, fruits, grasses, and grains were used in the diet.

2.3 Insecticides

Synthetic insecticides, Skitter® (cypermethrin 10% EC 250ml by Alnoor Agro chemicals) and deltamethrin® (deltamethrin in 2.5% EC by Jaffer Group of Companies) were purchased from the local market. Above insecticides were used with five different concentrations (25, 50, 100, 200 and 400 ppm)

2.4 Botanical extracts

There were three plant leaf extracts such as *Moringa oleifera*, *Ricinus communis,* and *Azadirachta indica* used with five different concentrations (2.5, 5, 10, 20, 40 ppm) against house cricket with three replications of each treatment.

2.5 Preparation of plant extracts

M. oleifera, *A. indica,* and *R. communis* leaves were collected from the surrounding forest. After collection, leaves were dried at room temperature in the shade. The leaves were cleaned with distilled water and put through an electric grinder to make a powder. In a conical flask, add 400ml of water and 40g of leaf powder. As a result, the extracts were kept in a refrigerator at 4°C. This liquid concentration was regarded as 100%.

2.6 Toxicity bioassay

The mortality rate of house cricket was checked by applying these extracts and insecticides at different concentrations. On filter paper in a petri dish, selected insecticide and extract concentrations were employed, and the filter paper was left to air dry at room temperature. To provide a water source for the crickets, a little piece of moistened tissue paper was pasted to the inner surface of the petri dish cover. In a petri dish, treated filter paper was dried. To make handling easier, the adult crickets were collected into a tiny bottle and refrigerated at 4°C for 5 minutes. The 20 adult crickets were placed on treated filter paper in each petri dish once it had cooled. Three replications and five treatments were applied. Petri dishes were kept at room temperature and covered with a lid. Mortality data was collected after 24, 48, 72, and 96 hours.

2.7 Statistical analysis

Comparison of the mean of each trial was done by using ANOVA under Completely Randomized Design (CRD).

3. RESULTS AND DISCUSSION

Among pesticides, cypermethrin pesticide showed maximum mortality (81.67%) at 400ppm concentration after 96 hours of treatment followed by 66.67% at 200ppm, 55% at 100ppm, 40% at 50ppm and 25% mortality at 25ppm. Current results were similar to Blank et al., (2012) and Maliszewska et al., (2018) who experimented on black field crickets and looked into pesticide-repelling ability respectively. Similarly, deltamethrin showed 76.67% mortality at 400ppm concentration after 96 hours, at 200ppm, 100ppm, 50ppm, and 25ppm pesticide showed 60%, 45%, 30%, and 18.33% mortality after 96 hours respectively. Current results were similar to Meena et al., (2014), Nataraj & Krishnamurthy (2012), Xia & Brandenburg (2000), Shar et al., (2016), Xia et al., (2023) and Richards et al., (2017) looked into the effect of deltamethrin on house cricket and some other insects. In comparison with plant extract *Azadirachta indica* (neem) plant extract showed 75% mortality at 40ppm after 96 hours, 20ppm showed 65% mortality, 10ppm showed 48.33% mortality, 5ppm showed 36.67% mortality and 2.5ppm showed 25% mortality of crickets after 96 hours. Our results were similar to Grasshopper et al., (2016), Oyarzabal-Armendariz et al., (2021), Lengai et al., (2020) and Imathiu et al., (2021). Castor (*Ricinus communis*) plant extract showed 68.33% mortality at 40ppm after 96 hours under laboratory conditions, 20ppm showed 58% mortality, 10ppm showed 48.33% mortality, 5ppm showed 35% mortality and 2.5ppm showed 23.33% mortality of crickets after 96 hours. Current results were similar to Hatem (2018) and Salimova et al., (2021) who checked the effect of castor on house cricket. Moringa (*Moringa oleifera*) plant extract showed 58.33% mortality at 40ppm after 96 hours under laboratory conditions, 20 ppm showed 51.67% mortality, 10 ppm showed 43.33% mortality, 5ppm showed 31.67% mortality and 2.5ppm showed 20% mortality of crickets after 96 hours. The death rate of *Acheta domesticus* L. decreased with decreasing concentrations and time. Similar results have been obtained by different researchers like Soltan et al., (2020), Margaret et al., (2022) and Ndubuaku et al., (2011) who checked the viability of moringa on adult crickets.

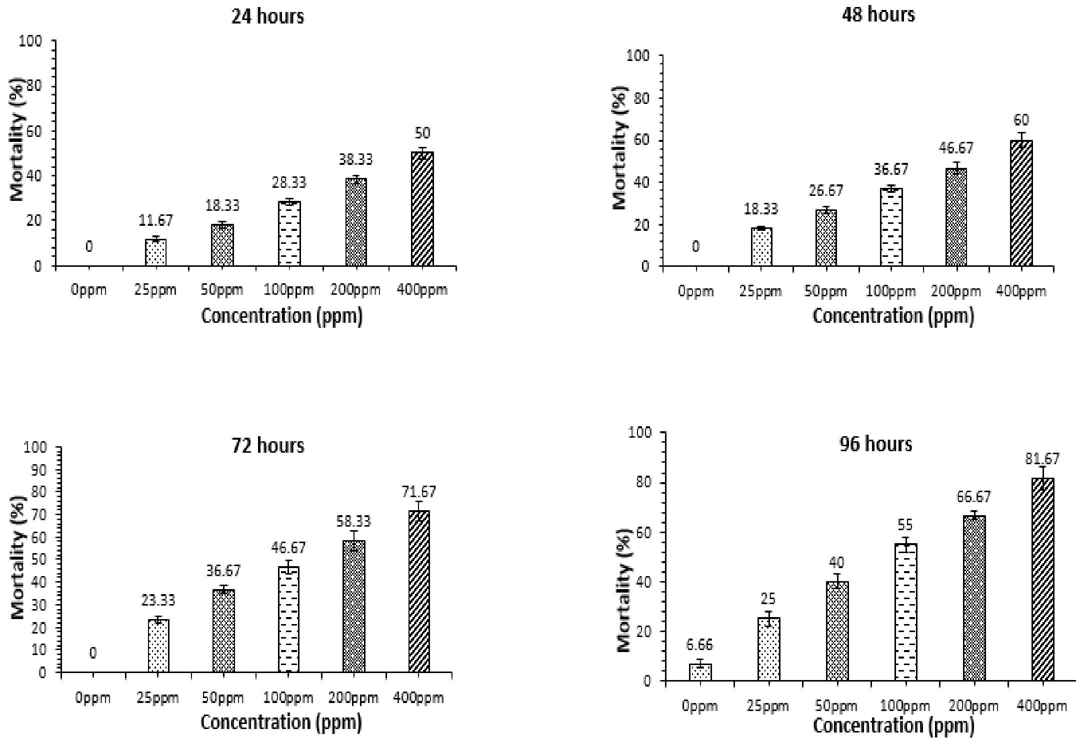

Figure 1. Percent mortality of Cypermethrin after 24,48, 72 and 96 hours of treatment.

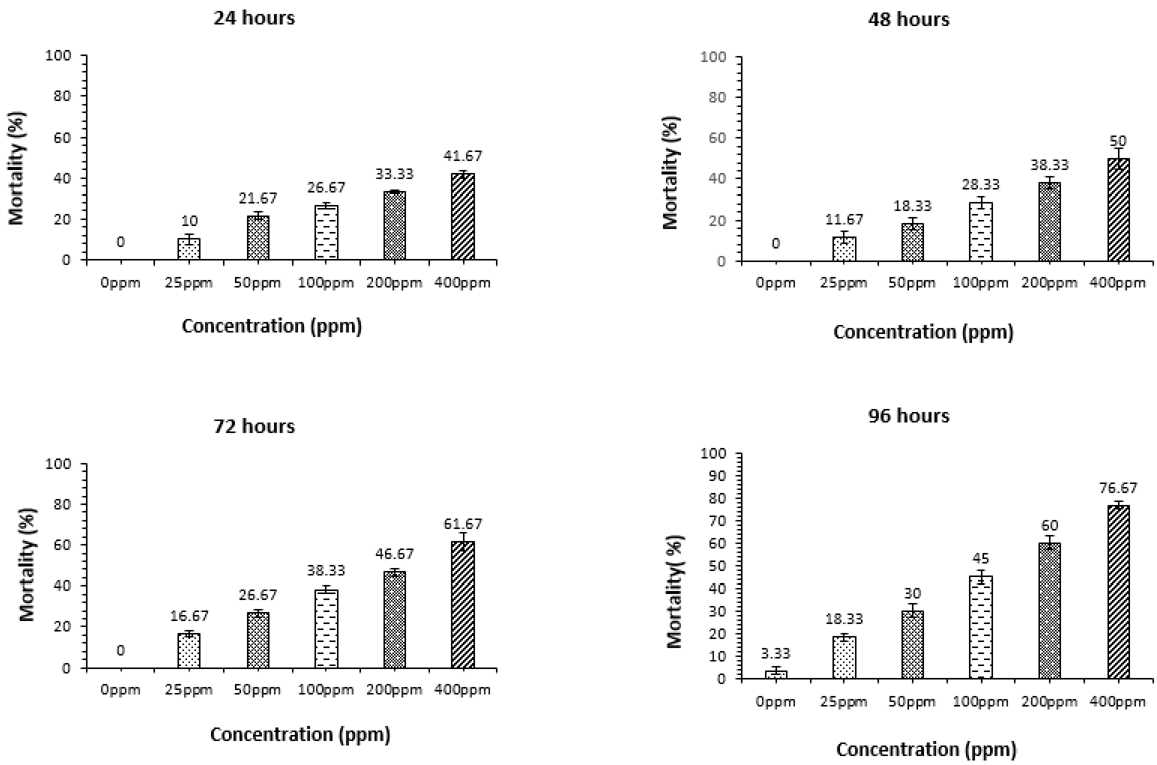

Figure 2. Percent mortality of Deltamethrin after 24,48, 72 and 96 hours of treatment.

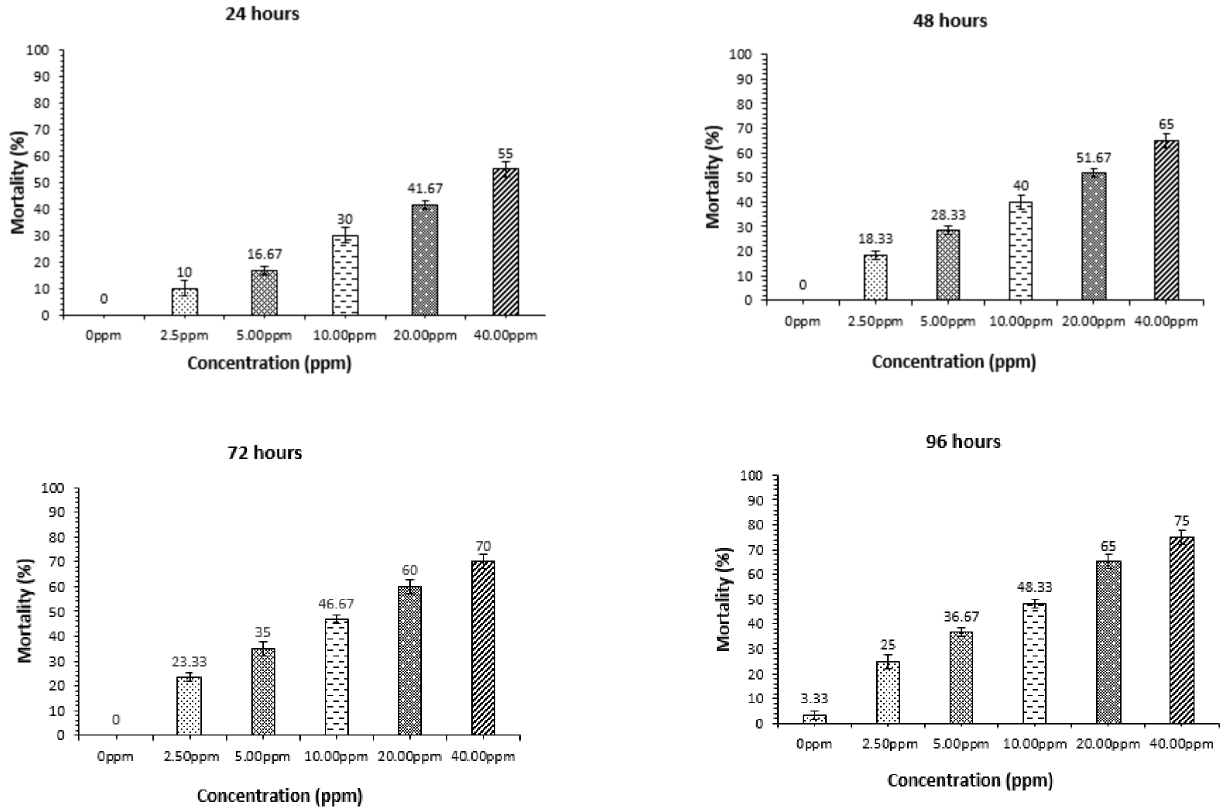

Figure 3. Percent mortality of *Azadirachta indica* extract after 24,48, 72 and 96 hours of treatment.

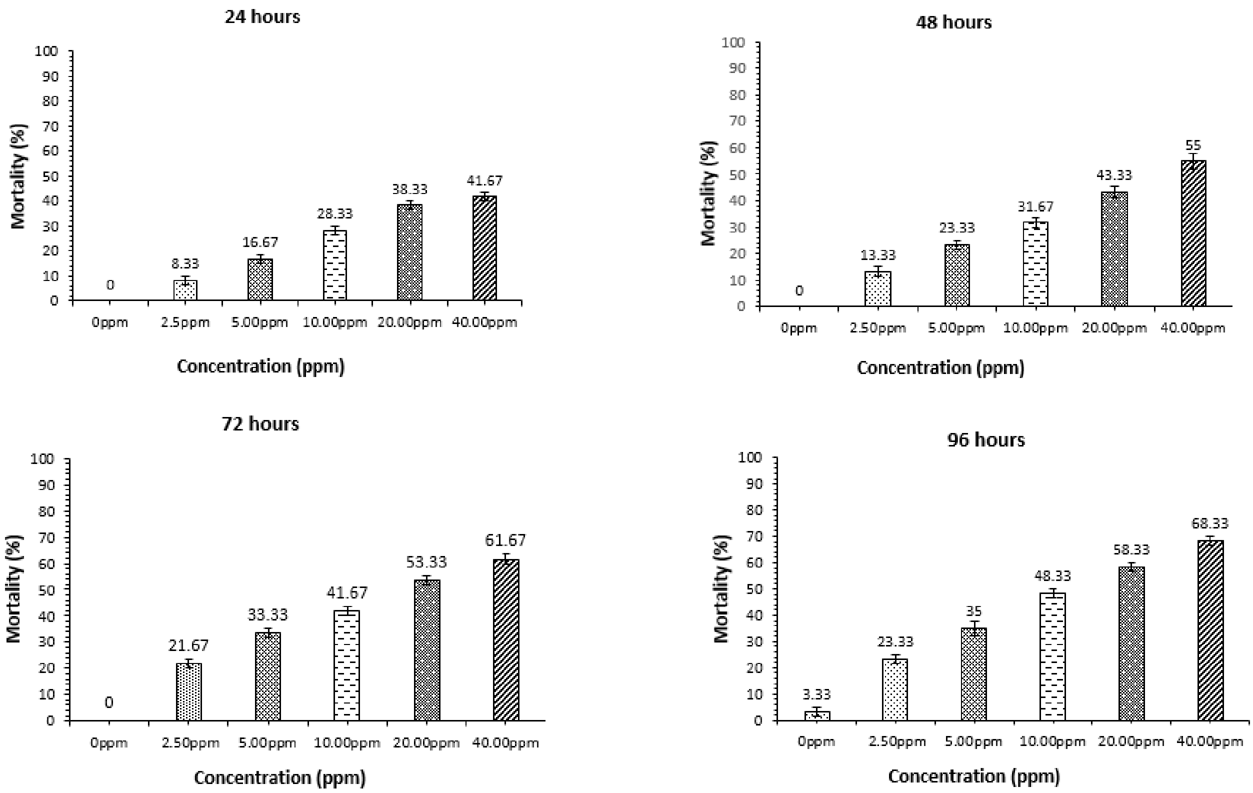

Figure 4. Percent mortality of *Ricinus communis* (castor) extract after 24,48, 72 and 96 hours of treatment.

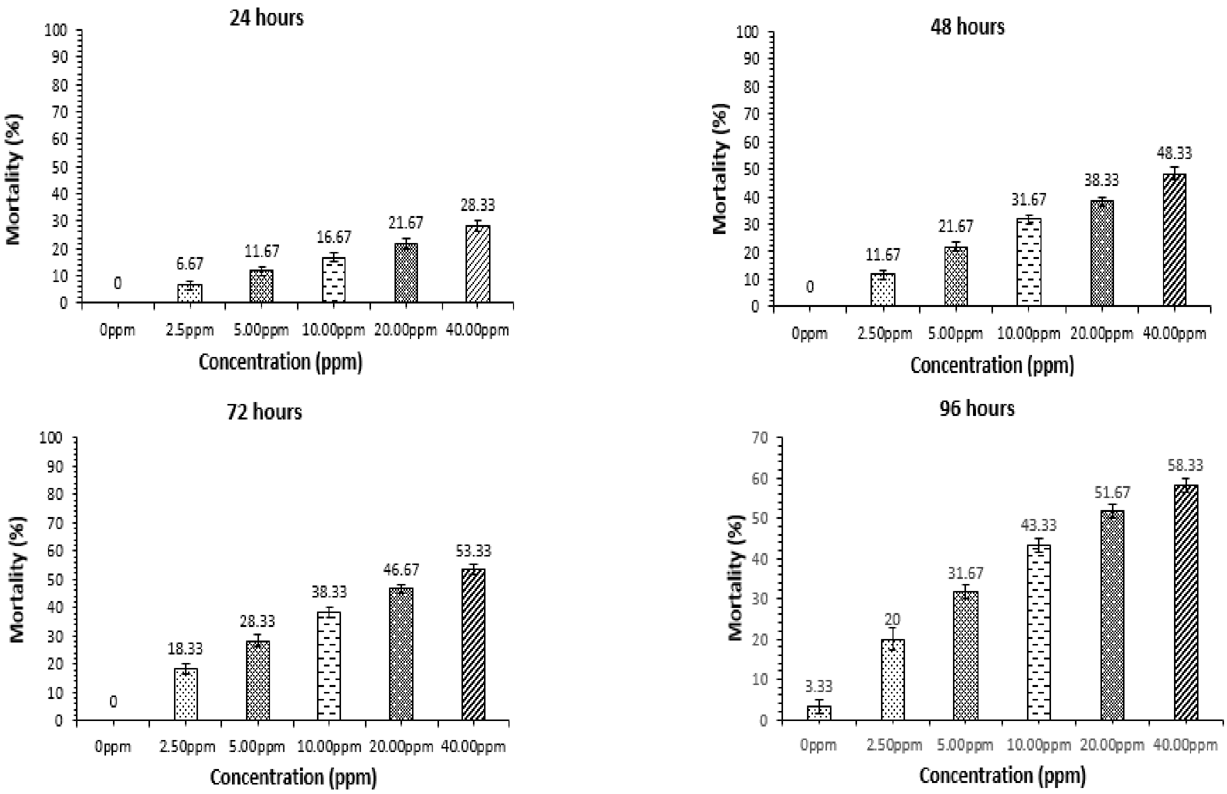

Figure 5. Percent mortality of *Moringa oleifera* (moringa) extract after 24,48, 72 and 96 hours of treatment

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