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Research Article

Environmental Strategies for Controlling the Greater Wax Moth *(Galleria mellonella L.)* Using Plant Extracts

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Abstract

In an advanced insect laboratory, the greater wax moth, *Galleria mellonella*, was collected and reared for the purpose of conducting experiments in this investigation. The efficacy of varying concentrations of both alcoholic and aqueous leaf extracts of Eucalyptus and *Aloe vera* in causing mortality of the seventh-instar larvae of the greater wax moth was assessed in these experiments. The total mortality of seventh-instar larvae treated with varying concentrations of the alcoholic and aqueous extracts of *Eucalyptus* and *Aloe vera* was also compared in the study, as was the effectiveness of the alcoholic and aqueous extracts of these two plants in achieving total larval mortality. A positive correlation was observed between the concentration used and the total mortality of the larvae. Specifically, the highest total mortality recorded for the seventh-instar larvae treated with the alcoholic and aqueous extracts of *Aloe vera* was 0.74 and 0.87, respectively. Likewise, a positive correlation was found between the total mortality of the seventh-instar larvae and the concentrations used for the alcoholic and aqueous extracts of *Eucalyptus*, with the highest mortalities being 0.52 and 0.87, respectively. Furthermore, when comparing the total mortalities of larvae treated with the alcoholic versus aqueous extracts of *Aloe vera*, the highest mortality rates were 1.14 and 1.42, respectively, at a concentration of 60 mg/ml. In contrast, the highest overall mortality rates for larvae treated with the alcoholic and aqueous extracts of *Eucalyptus* were 1.20 and 1.24, respectively, also at a concentration of 60 mg/ml.

1. Introduction

The greater wax moth, *Galleria mellonella* L., is one of the most significant pests affecting honey bee colonies worldwide, as it damages stored beeswax and causes considerable economic losses each year. It is a persistent and economically important pest that attacks the frames of stored beeswax, the wooden parts of the hive, as well as the stored beeswax, pollen, honey, and shed skins, and it also targets weak honey bee colonies [1]. Both the adult and larval stages of the greater wax moth are capable of transmitting pathogenic microorganisms that cause serious diseases in bees, such as foulbrood, which can overrun an entire colony. Moreover, the feces of the greater wax moth contain large quantities of bacterial spores of *Paenibacillus larvae*; this pest inflicts significant damage on bee colonies by deteriorating the cell frames. For example, in the United States, beekeepers lost approximately 3,300 bee colonies in 1985, and substantial damage was also recorded in weak colonies and stored frames, with losses increasing over the years to reach $800,000 in 1994. The greater wax moth is present in all regions where honey bees are reared and in apiaries, becoming most active in warm areas at temperatures above 27°C, where its prevalence is particularly high [2].

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Chemical Control Methods and Alternatives

Chemical control is one of the most commonly used methods for managing this pest, requiring special care and precautions to prevent the pesticides from reaching honey. Some of the pesticides include methyl bromide, aluminum phosphate, and calcium cyanide [3]. However, chemical control has become undesirable due to the risks associated with pesticide residues or chemicals used, and consumers' concerns about contamination of their food and products with toxins from these substances. As previously mentioned, it is now necessary to search for more environmentally and human- and animal-safe control methods. There are various predators and parasites that naturally control the greater wax moth, such as the predator Xylocoris flavipes on the eggs and larvae of the greater wax moth, and the parasite Cryptus inculcator on the larvae and pupae [4]. Due to the drawbacks of chemical pesticides, including their toxic effects on honey bees and other beneficial insects, as well as the emerging resistance in more than 600 pest species to various chemical pesticides, it is essential to develop suitable alternatives to control these pests or at least incorporate other control methods alongside chemical ones. One promising alternative is the use of plant extracts as effective natural control agents. These extracts affect insects in multiple ways, including being non-toxic or sterilizing, regulating insect growth, altering their behavior, or inhibiting feeding or egg-laying. These plant-derived control agents are successful against insects due to their desirable properties, such as rapid degradation under light, heat, and moisture conditions, transforming into non-polluting materials for the environment [5]. Furthermore, resistance to these treatments has not been observed in the treated insects [6] for 18 seconds.

Chemical control is one of the most commonly used methods to combat this pest, but it requires special care and precaution to ensure that these pesticides do not reach the honey. Among these pesticides are methyl bromide, aluminum phosphate, and calcium cyanide [3]. Chemical control of pests has become undesirable due to the risks posed by pesticide residues and the chemicals used, as well as consumers' fears of contaminating their food and products with these toxins. In light of the above, it has become imperative to search for pest control agents that are safer for the environment and for human and animal health.

There are many predators and parasites that help control the greater wax moth. In Iraq, for example, the predator *Xylocoris flavipes* has been recorded attacking the eggs and larvae of the greater wax moth, and the parasite *Cryptus inculcator* has been observed on its larvae and pupae [4]. Moreover, given the disadvantages of chemical pesticides and predators—including their Because of the harmful effects on honey bees and other beneficial insects—and because over 600 insect pest species have developed resistance to different chemical pesticides—it is crucial to find appropriate substitutes for chemical control methods, or at the very least, to use them in conjunction with other strategies.

One promising alternative is the use of plant extracts as natural pest control agents. These extracts work in several ways: they are non-toxic, can induce sterility, regulate insect growth, alter insect behavior, and have antifeedant or oviposition-inhibiting effects. They are effective against insects because they possess many desirable characteristics, such as rapid degradation due to their sensitivity to light, heat, and humidity, which leads to their conversion into environmentally benign substances [5]. Meanwhile, no resistance has been recorded in insects treated with these extracts [6].

Recent research has focused on finding natural plant-derived substances for pest control that do not affect non-target organisms or have minimal practical effects [7]. Various essential oils from plants such as clove (Eugenia aromatic), basil (Ocimum basilicum), thyme (Thymus vulgaris), eucalyptus species (Eucalyptus spp.), peppermint (Mentha viridis), and lemongrass (Cymbopogon citratus) were used alongside chemical control agents to determine the lethal dose for the fifth instar larvae of the greater wax moth *(Galleria mellonella)* and their impact on the insect's life cycle. Ethanolic extracts from twenty-four plant species were also evaluated for their effects on the growth of the greater wax moth larvae and worker honey bees. The most effective treatments were extracts from Abrus precatorius, Laurus nobilis, Petroselinum sativum, and Plantago psyllium, which killed 100% and 95% of the adult greater wax moths, respectively, without affecting the worker honey bees, except in the case of the A. precatorius extract [8]. In another study, the percentage of sixth instar larvae mortality of the greater wax moth treated with seed oils of Nigella sativa (black seed), Allium sativum (garlic), and Trigonella foenum-graecum (fenugreek), along with other chemical and biological control agents, showed that the seed oils of fenugreek and garlic provided the highest larval mortality rates of 67.5% and 60.2%, respectively, when compared to other control methods. Additionally, [9] studied the effect of eucalyptus oil extracts on the greater wax moth, finding a reduction in egg hatching rates to 1.33% at a 10% concentration. Moreover, [10] reported the presence of 348 plant species with antifeedant properties, 27 plant species with insect-repellent effects, 31 plant species that inhibit growth, and 5 general plant species. The quantity and quality of these compounds vary between plant species and seasons, imparting specific pesticidal traits to each species [11] for 25 seconds.

Recent research has focused on identifying natural, plant-derived substances for pest control so that they do not affect non-target organisms or have only minimal effects [7]. Various essential oils from *several plant species—such as clove (Eugenia aromatic), Ocimum basilicum, thyme (Thymus vulgaris), Eucalyptus spp., mint (Mentha viridis),* and *lemongrass (Cymbopogon citratus)*—were used in combination with other chemical control agents to determine the lethal dose for the fifth instar larva of the greater wax moth, as well as to assess their impact on the insect's life cycle.

In addition, ethanol extracts from 24 specific medicinal plants were evaluated for their effects on the growth of the greater wax moth and on honey bee workers. The most effective treatments were the extracts of *Abrus precatorius, Laurus nobilis, Petroselinum sativum, and Plantago psyllium,* which killed 100% and 95% of the adult greater wax moths treated, respectively, without affecting the honey bee workers—except in the case of the A. precatorius extract [8].

In another study, the percentage of larvae of the greater wax moth treated with the essential oil extracts of black seed *(Nigella sativa)*, garlic *(Allium sativum)*, and fenugreek *(Trigonella foenum-graecum)*, along with other chemical and biological control agents, was assessed. The essential oil extracts of fenugreek and garlic resulted in the highest larval mortality rates, at 67.5% and 60.2%, respectively, compared to the other control agents. Similarly, [9] reported in their study on the effect of eucalyptus tree essential oil on the greater wax moth that the egg hatch rate decreased to 1.33 at a concentration of 10%.

Ricardo, [10] noted that there are 348 plant species with antifeedant effects, 27 plant species that repel insects, 31 plant species with growth-inhibiting effects, and 5 general plant species. The quantity and quality of these substances vary from one plant species to another and from one season to another, with these specific characteristics being inherent to each plant [11].

Due to the damage caused by the greater wax moth, and to reduce the material and environmental losses, this study was conducted with the following objectives: 1. Rearing the greater wax moth for several generations in the laboratory. 2. Assessing the efficacy of both alcoholic and aqueous extracts from Eucalyptus and Aloe vera plants in causing mortality in the seventh instar larvae of the greater wax moth. 3. figuring out the optimal concentration of alcoholic and aqueous extracts from aloe vera and eucalyptus to efficiently kill the larger wax

moth larvae in their seventh instar. 4. Examining the effects of alcoholic and aqueous extracts of Aloe vera and Eucalyptus camaldulensis on larger wax moth larvae in their seventh instar. Materials and Procedures Gathering and Raising Greater Wax Moths: In April 2023, frames of beeswax infested with different stages of the larger wax moth's (G. mellonella) larvae were gathered from a nearby apiary in the Al-Abbasiya district.

The larvae present on the wax frames were transferred to the Advanced Insect Laboratory at the College of Education for Girls for rearing multiple generations. The rearing was conducted under lab conditions and complete darkness. A portion of the larvae was placed in large plastic bottles containing clean beeswax, and the openings were sealed with tulle cloth and secured with rubber stoppers to prevent larval escape. These bottles were then covered with cloth to block light. Additionally, some infested frames were placed in closed wooden boxes to obtain adult moths. After the adults appeared in the plastic bottles or were collected in breeding boxes, they were directly transferred to the mating cages. Each mating cage contained a strip of cardboard for the moths to lay eggs on, and a small amount of beeswax was added for feeding. The eggs laid by the adults were left in the wax-containing bottles to allow the larvae to hatch and feed directly on the wax. for 28 seconds.

In light of the damage caused by the wax moth and to reduce both economic and environmental losses, this study was conducted with the following objectives:

• Rearing the greater wax moth for several generations under laboratory conditions.
• Evaluating the efficacy of both the alcoholic and aqueous extracts of *Aloe vera* and *Eucalyptus camaldulensis* in causing mortality in the seventh instar larvae of the greater wax moth.
• Determining the optimal concentration of the aqueous and alcoholic extracts of Eucalyptus that are lethal to the seventh instar larvae of the greater wax moth.
• Comparing the effects of the aqueous and alcoholic extracts of the two plant types—*Aloe vera* and *Eucalyptus camaldulensis*—on the seventh instar larvae of the greater wax moth.

Materials and Methods

Collection and Rearing of the Greater Wax Moth

Wax frames infested with various larval stages of the greater wax moth *(Galleria mellonella)* were collected from a local apiary in the Abbasiya region during April 2023. The larvae present in these frames were then transferred to the Advanced Insect Laboratory at the College of Education for Girls, where they were reared for several generations under laboratory conditions in complete darkness.

Subsequently, a portion of the larvae was placed in large plastic jars containing clean wax. The openings of these jars were covered with muslin cloth and sealed with a rubber stopper to prevent the larvae from escaping, and the jars were further wrapped in cloth to block out light. In addition to rearing the larvae in these jars on their natural food (wax), some of the infested frames were placed in closed wooden boxes to obtain adults. Once the adults emerged in the plastic jars or were collected from the wooden rearing boxes, they were immediately transferred to mating cages.

In each mating cage, a strip of cardboard was provided as a substrate for egg-laying, and a small amount of wax was added as food. The eggs laid by the adults were left in the jars containing wax so that the newly hatched larvae could feed directly on it.

Collection of *Eucalyptus and Aloe vera* Plants

The leaves of *Eucalyptus camaldulensis* were collected from public gardens during May 2023. They were cleaned and dust was removed without washing them with water. As for *Aloe vera* leaves, they were purchased from local nurseries in Najaf Al-Ashraf city and underwent the same cleaning and cutting procedures as those used in the preparation of the *Eucalyptus* extract.

Preparation of *Eucalyptus* and *Aloe vera* Aqueous Extracts

The extract was prepared following the modified method of [12], which was originally adapted from [13]. *Eucalyptus* leaves were cut into small pieces and spread on newspaper in a shaded, well-ventilated area with frequent turning to prevent fungal contamination. This process lasted for ten days until complete drying was achieved. The dried plant material was then ground using an electric grinder to obtain a fine powder, which was stored in clean, sterilized glass bottles labeled with the sample name and collection site.

To prepare the aqueous extract of *Eucalyptus* and *Aloe vera*, 20 grams of the powdered plant material was placed in a 500 mL glass beaker containing 400 mL of distilled water. The mixture was stirred and left for 24 hours, after which it was filtered through two layers of muslin cloth followed by filtration using filter paper in a funnel, discarding the residue. The filtrate was then placed in an electric oven at 45°C to evaporate the water and obtain a dry extract. A total of 6 grams of the dried extract was dissolved in 100 mL of distilled water, resulting in a solution with a concentration of 6 mg/mL. From this stock solution, different concentrations (15, 30, 45, and 60 mg/mL) were prepared using the dilution formula:

$N_1 \times V_1 = N_2 \times V_2 N_1 \times V_1 = N_2 \times V_2$
Where:
• N_1 = Initial concentration
• V_1 = Initial volume
• N_2 = Concluding concentration
• V_2 = Concluding volume

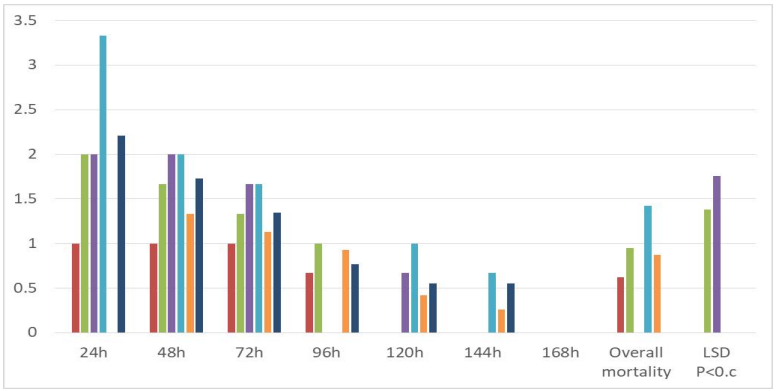

Figure 1: The alcohol extract effect of olphera leaves in the destruction of phase VII larvae of the greater wax moth

Preparation of Eucalyptus and *Aloe vera* Alcoholic Extracts

The alcoholic extracts of Eucalyptus and *Aloe vera* were prepared by taking 20 grams of the powdered plant material and placing it in a 500 mL glass beaker containing 400 mL of ethanol. The mixture was stirred, and then left for 24 hours. The solution was filtered through two layers of muslin followed by filter paper in a funnel, discarding the residue [14]. The filtrate was then placed in an electric oven at 45°C to evaporate the ethanol, yielding the dry extract. Six grams of the dry extract were dissolved in 100 mL of ethanol, resulting in a 6% (mg/mL) solution. From this, concentrations (15, 30, 45, and 60 mg/mL) were prepared using the dilution formula: [$N_1 \times V_1 = N_2 \times V_2$] Where: - N_1 = Initial concentration - V_1 = Initial volume - N_2 = Final concentration - V_2 = Final volume Treatment of the Seventh Instar Stage of Greater Wax Moth Larvae: The food (wax material) was treated with the alcoholic and aqueous Eucalyptus extracts and the alcoholic and aqueous Aloe vera extracts at concentrations of 15, 30, 45, and 60 mg/mL, separately. The food was sprayed with the respective extract and concentration, well-mixed with the food. Ten larvae of the seventh instar stage were added to each treatment dish, with three replicates for each concentration of the extracts. Additionally, three petri dishes with untreated food (sprayed only with distilled water) were used as a control group, with ten larvae each. Data was recorded on the petri dishes for the purpose of monitoring mortality seven days after treatment. The dishes were kept in an incubator at a temperature of 28 ± 2°C and relative humidity of 50 ± 10%. for 21 seconds.

Preparation of the Alcoholic Extract of *Eucalyptus* and *Aloe vera*

Alcoholic extracts of *Eucalyptus* and *Aloe vera* were prepared by taking 20 g of the powder and placing it in a 500 mL glass beaker containing 400 mL of ethanol. The contents were mixed, and the mixture was left undisturbed for 24 hours. Afterward, the solution was filtered through two layers of muslin cloth followed by filter paper in a funnel, discarding the residue [14]. The filtrate was then placed in an electric oven at 45°C to evaporate the alcohol and obtain the dry material. Six grams of the dry material were dissolved in 10 0mL of ethanol, resulting in a solution with a concentration of 6 mg/mL. From this stock solution, further concentrations of 15, 30, 45, and 60 mg/mL were prepared using the dilution formula:

$N_1 \times V_1 = N_2 \times V_2 N_1 \times V_1 = N_2 \times V_2 N_1 \times V_1 = N_2 \times V_2$
where:
- N_1 = initial concentration
- V_1 = initial volume
- N_2 = final concentration
- V_2 = final volume

Treatment of the Seventh Instar Larvae of the Greater Wax Moth

The diet (wax substance) was treated separately with both the alcoholic and aqueous extracts of *Eucalyptus* and *Aloe vera* at concentrations of 15, 30, 45, and 60 mg/mL. To do this, the diet was sprayed with the respective extract at the designated concentration and mixed thoroughly. Ten seventh-instar larvae were then added to each plate, with each plate representing one replicate; three replicates were prepared for each extract concentration. Additionally, three Petri dishes containing untreated diet (sprayed only with distilled water) were prepared, each receiving ten larvae to serve as the control group. Data were recorded from the plates to monitor mortality after seven days of treatment, following incubation at 28±2°C and 50±10% relative humidity.

Effect of the Aqueous Extract of *Aloe vera* Leaves on the Mortality of the Seventh Instar Larvae of the Greater Wax Moth

The mortality rates of the seventh instar larvae using the aqueous extract showed that the highest mortality rate recorded was 1.67 at concentrations of 45, 60, and 30 mg/mL after 24, 48, and 72 hours, respectively, while the lowest mortality rate was 0.33 at a concentration of 15 mg/mL after 48, 144, and 168 hours of treatment. In addition, the highest overall mortality rate for the larvae was 1.33 at 24 hours, and the highest overall mortality rate based on the concentrations used was 1.20 at 60 mg/mL, as presented in Figure 2.

Jesikha (2012) confirmed that mortality in *Musca domestica* larvae treated with the aqueous extract of *Aloe vera* increases with the concentration used, with larval mortality rising from 35% at 20 ppm to 100% at 100 ppm, compared to 5% in the control group.

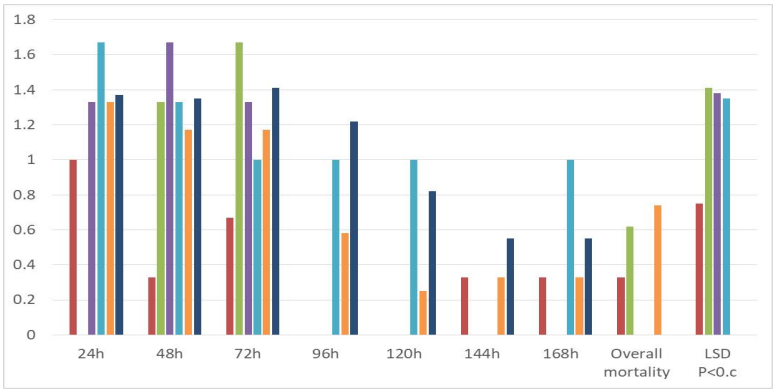

Figure 2: Effect of the Aqueous Extract of *Aloe vera* Leaves on the Mortality of the Seventh Instar Larvae of the Greater Wax Moth

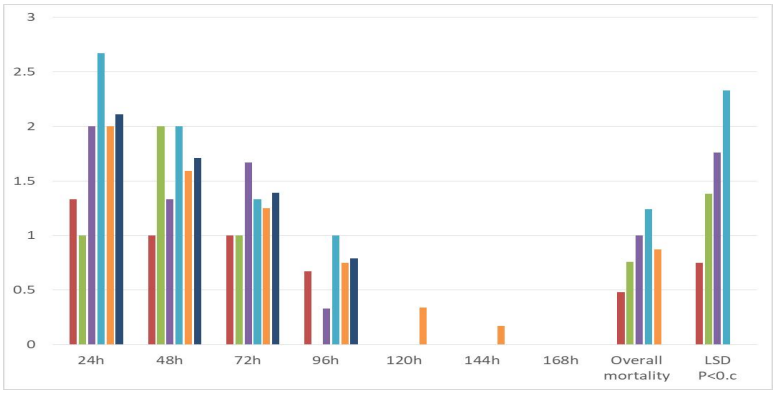

Figure 3: Effect of the Alcoholic Extract of *Eucalyptus* Leaves on the Mortality of the Seventh Instar Larvae of the Greater Wax Moth

Impact of the Eucalyptus Leaf Alcoholic Extract on the Greater Wax Moth's Seventh Instar Larvae Mortality The greatest death rate of 3.33 larvae was seen at a dose of 60 mg/mL after 24 hours in the larger wax moth's seventh instar larvae when exposed to an alcoholic extract of eucalyptus leaves. After 168 hours, however, no mortality (0 larvae) was seen at all of the concentrations (15, 30, 45, and 60 mg/mL). It was observed that the highest overall mortality rate for the larvae was 2 after 24 hours, and the highest overall mortality rate based on the concentrations used was 1.24 larvae at a concentration of 60 mg/mL, as shown in Figure 3. It is evident that the alcoholic extract of Eucalyptus leaves contains saponins, tannins, alkaloids, steroids, flavonoids, phenols, and essential oils. These components are most effective in inhibiting mortality in seventh instar larvae when compared to the aqueous extract. A study by [15] indicated that the ethanolic extract of Datura fruits (Datura inoxia) affected the mortality rate of the larval stages of the Trogoderma granarium, with mortality rates for the five larval stages being 90.0%, 70.1%, 61.2%, 41.2%, and 35.2%, compared to a control group mortality of 12.3%. Figure 3 Effect of the Alcoholic Extract of *Eucalyptus* Leaves on the Mortality of the Seventh Instar Larvae of the Greater Wax Moth. for 23 seconds.

Effect of the Aqueous Extract of Eucalyptus Leaves on the Mortality of the Seventh Instar Larvae of the Greater Wax Moth The results revealed that the aqueous extract of Eucalyptus leaves contains steroids, saponins, glycosides, tannins, flavonoids, phenols, and volatile oils, which play an effective inhibitory role in the mortality of the seventh instar larvae of the greater wax moth. There was a slight relationship between the mortality rates and the concentration used, where the lowest mortality rate (0.33 larvae) was at a concentration of 15 mg/mL after 48, 144, and 196 hours, and the highest mortality rate (1.67 larvae) was at concentrations of 30, 45, and 60 mg/mL after 24, 48, and 72 hours, as shown in Figure 4. It is noteworthy that the aqueous extract had less effect than the alcoholic extract of Eucalyptus leaves on the mortality of the seventh instar larvae of the greater wax moth. [16] reported that the aqueous extract of the leaves, roots, and fruits of the Citrullus colocynthis plant caused mortality rates ranging between 50-100% in the fourth instar larvae, the last larval stage of Culex molestus at a concentration of 1000 mg/mL. Figure 4 Effect of the Aqueous Extract of *Eucalyptus* Leaves on the Mortality of the Seventh Instar Larvae of the Greater Wax Moth. for 19 seconds

Effect of the Aqueous Extract of *Eucalyptus* Leaves on the Mortality of the Seventh Instar Larvae of the Greater Wax Moth

The results indicated that the aqueous extract of *Eucalyptus* leaves contains steroids, saponins, glycosides, tannins, flavonoids, phenols, and volatile oils, which play an effective inhibitory role in the mortality of the seventh instar larvae of the greater wax moth.

There is a slight relationship between larval mortality rates and the concentration used. The lowest mortality rate—0.33 larvae—was observed at a concentration of 15 mg/mL after 48, 144, and 196 hours, while the highest larval mortality rate—1.67 larvae—was recorded at concentrations of 30, 45, and 60 mg/mL after 24, 48, and 72 hours, respectively (see Figure 4).

It is also evident that the aqueous extract is less effective than the alcoholic extract of *Eucalyptus* leaves in inducing mortality in the seventh instar larvae of the greater wax moth. According to Lahaz [16], the aqueous extract of the leaves, roots, and fruits of the plant, *Culexcolocyuthis*, caused larval mortality rates ranging between 50–100% in the fourth instar—the final larval stage of the mosquito *Culex molestus*—at a concentration of 1000 mg/mL.

Comparison of Total Mortalities in the Seventh Instar Larvae of the Greater Wax Moth *(Galleria mellonella)* Treated with Different

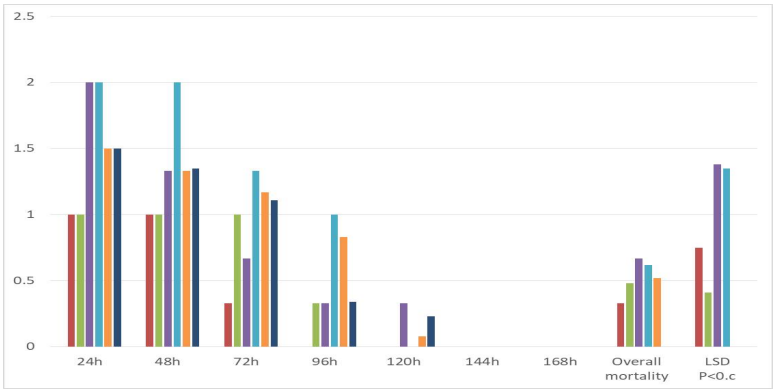

Figure 4: Effect of the Aqueous Extract of *Eucalyptus* Leaves on the Mortality of the Seventh Instar Larvae of the Greater Wax Moth

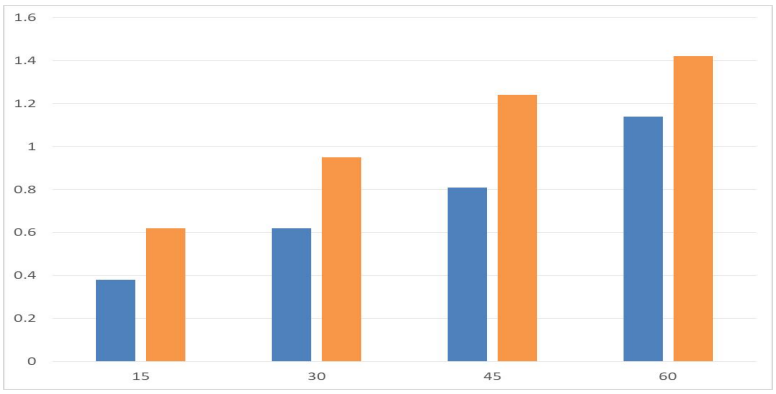

Figure 5: Comparison of Total Mortalities in the Seventh Instar Larvae of the Greater Wax Moth *(Galleria mellonella)* Treated with Different Concentrations of the Alcoholic and Aqueous Extracts of *Eucalyptus* and *Aloe vera*.

Concentrations of the Alcoholic and Aqueous Extracts of *Eucalyptus* and *Aloe vera*

The results presented in Figure 5 indicate that the alcoholic extract of *Eucalyptus-Aloe vera* was more effective in causing mortality in the seventh instar larvae of the greater wax moth than the aqueous extract of *Eucalyptus* and *Aloe vera* at all concentrations used in the experiment. The highest mortality rates were recorded at a concentration of 60 mg/mL, where the mortality rates for the alcoholic and aqueous extracts were 1.42 and 1.14 larvae, respectively.

Goodwin [17] reported that the effectiveness of the alcoholic extract of henna is due to the potency of its toxic compounds, which inhibit feeding or affect the protase enzyme in the midgut, thereby reducing sugar and protein levels.

Comparison of Total Mortalities in the Seventh Instar Larvae of the Greater Wax Moth *(Galleria mellonella)* Treated with Different Concentrations of the Alcoholic and Aqueous Extracts of Eucalyptus The results presented in Figure 6 indicate that the aqueous extract of Eucalyptus was more effective in causing mortality in the seventh instar larvae of the greater wax moth than the aqueous extract of Aloe vera at all concentrations used in the experiment. The highest mortality rates were recorded at a concentration of 60 mg/mL, where the mortality rates for the alcoholic and aqueous extracts were 1.24 and 1.20 larvae, respectively. [18] reported that the effectiveness of aqueous extracts from plants such as *Eucalyptus*, Sabhbah, Cactus, and Camphor in inducing mortality in the fourth instar larvae of the mosquito Culex reached 100%. Figure 6: Comparison of Total Mortalities in the Seventh Instar Larvae of the Greater Wax Moth *(Galleria mellonella)* Treated with Different Concentrations of the Alcoholic and Aqueous Extracts of *Eucalyptus* for 46 seconds.

Comparison of Overall Mortalities in the Seventh Instar Larvae of the Greater Wax Moth *(Galleria mellonella)* Treated with Different Concentrations of the Alcoholic and Aqueous *Eucalyptus* Extract

The results presented in Figure 6 indicated that the aqueous eucalyptus extract was more effective in causing mortality in the seventh instar larvae of the greater wax moth than the aqueous *Aloe vera* extract at all concentrations used in the experiment. The highest mortality rates were recorded at a concentration of 60 mg/mL, where the mortality rates for the alcoholic extract and the aqueous extract were 1.24 and 1.20 larvae, respectively.

Al-Zaher, [18] reported that the effectiveness of the aqueous extracts of the plants *Al-Yas, Al-Sabahbah*, Aloe, and camphor in the mortality rate of the fourth instar larvae of Culex mosquitoes reached 100%.

Comparison of the Efficiency of Alcoholic Extracts of *Aloe vera* and *Eucalyptus* in the Total Mortality of Seventh Instar Larvae of the Greater Wax Moth

The results in Figure 7 showed that the effectiveness of the alcoholic extract of *Aloe vera* was higher than that of the alcoholic extract of *Eucalyptus*, leading to larval mortality rates of 1.42% and 1.24%, respectively. Additionally, the mortality rates for the aqueous extract of *Aloe vera* were higher than those of the aqueous extract of *Eucalyptus* at all concentrations used in the experiment.

Study by Akbar et al.[12] indicated variations in the effects of alcoholic extracts of henna leaves and olive pulp in causing mortality in the third instar of the blue bottle fly *(Lucilia sericata)*. The mortality rates recorded were 10% and 33.33% when treated with a 25% concentration of the alcoholic extract of henna and olive pulp, respectively.

Comparison of the Efficiency of Aqueous Extracts of *Aloe vera* and *Eucalyptus* in the Total Mortality of Seventh Instar Larvae of the Greater Wax Moth.

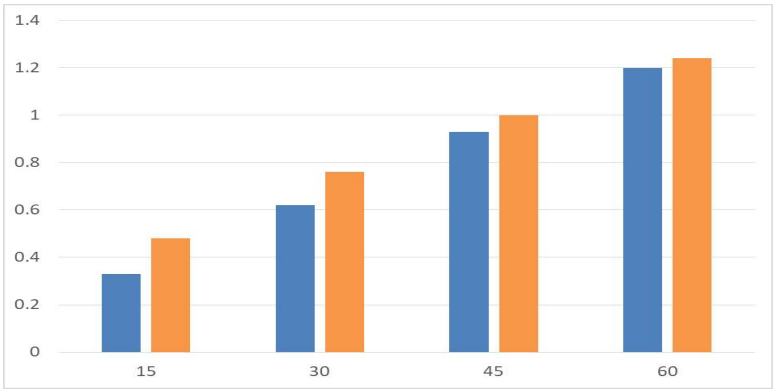

Figure 6: Comparison of Total Mortalities in the Seventh Instar Larvae of the Greater Wax Moth Comparison of Overall Mortalities in the Seventh Instar Larvae of the Greater Wax Moth *(Galleria mellonella)* Treated with Different Concentrations of the Alcoholic and Aqueous *Eucalyptus* Extract

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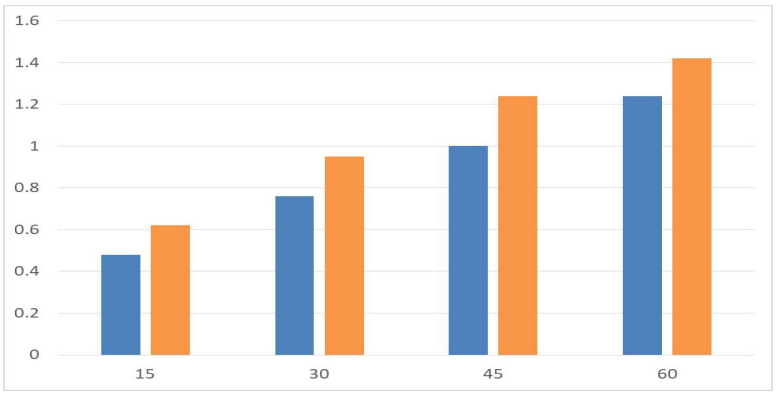

Figure 7: Comparison of the Efficiency of Alcoholic Extracts of *Aloe vera* and *Eucalyptus* in the Total Mortality of Seventh Instar Larvae of the Greater Wax Moth

The results in Figure 8 indicated that the effectiveness of the aqueous extract of *Aloe vera* was higher than that of the aqueous extract of *Eucalyptus*, leading to larval mortality rates of 1.20% and 0.62%, respectively. The mortality rates for the aqueous extract of *Aloe vera* were higher than those of *Eucalyptus* at all concentrations used in the experiment.

Al-Rubaie et al. [19] reported that the aqueous extracts of neem and chinaberry had an effect on the cumulative mortality rates of nymphs and adults of the dubas bug. Additionally, a study by Akbar et al. [12] showed that the aqueous extracts of henna leaves and olive pulp differed in their effects on second instar larvae of the housefly, with mortality rates of 36.66% and 26.66% for the aqueous extracts of henna and olive pulp, respectively.

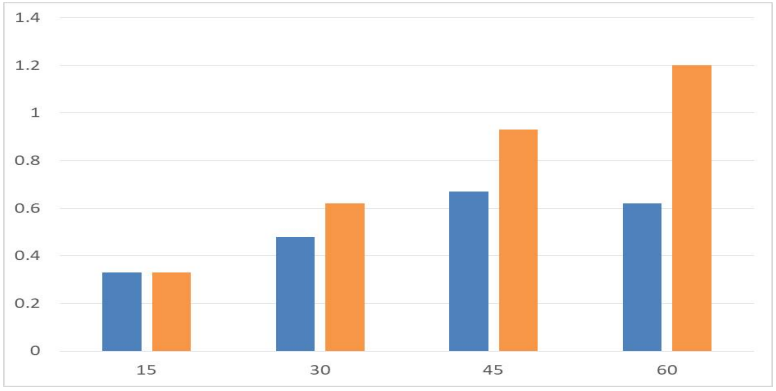

Figure 8: Comparison of the Efficiency of Aqueous Extracts of *Aloe vera* and *Eucalyptus* in the Total Mortality of Seventh Instar Larvae of the Greater Wax Moth

References

[1] P. Warhust and R. Goebel. The bee book, beekeeping in the warmer areas of australia. state of queensland, department of primary industries. 244pp., 2000.

[2] S. Senthil Nathan and K. Kalaivani. Efficacy of nucleopolyhedrovirus (npv) and azadirachtin on spodopteraliturafabricius (lepidoptera: Noctuidae). *Biological Control*, 34:93–98, 2005.

[3] R. D. Williams Goodman, P. Oldroyd, B. P., and J. Hoffman. Studies on the use of phosphine for the control of greater wax moth, galleria mellonella in stored honeybee comb. *American Bee Journal*, 130:437–477, 2003.

[4] I. H. Bowen and K. P. Perera. Alkaloid, coumarins and flavonoids of micromelumzeylanicum. 21:433–437, 1982. Phytochemistry.

[5] R. Pavela. Possibilities of botanical insecticide exploitation in plant protection. *Pest Technology*, 1:47–52, 2007.

[6] Awad Shaaban and Nizar Mustafa Al-Mallah. Pesticides. ministry of higher education and scientific research. dar al-kutub for printing and publishing, university of mosul. *520 pages*, 1993.

[7] Y. C. Ho Su, E. I. C. L. Wang, and S. T. Chang. Antifungal activities and chemical compositions of essential oils from leaves of four eucalyptus sci taiwan j for. *Vol.(21)*, 61:49, 2006.

[8] O. O. Sande M. M. Ayepola and B. A. B. A. Adeniyi. The antibacterial activity of leaf extracts of eucalyptus camaldulensis (myrtaceae). 4(11):1410–1413, 2008. Journal of Applied Sciences Research.

[9] P. Bhawana and S. Sheetal. Evaluation of antimicrobial potential of eucalyptuscamaldulensis. *Journal of Pharmaceutical. Chemical and Biological*, 5:148–158, 2014.

[10] M. J. Didier V. L. Ricardo and M. 2022 Loffler. plants extracts and utilization of their products for safe agricultural production and for ceduction environmental. *Ciência Rural, Santa Maria*, 52 . (5:91–99.

[11] I. M. Kelany. Plant extracts and utilization of their products for safe agricultural production and for reducing environmental pollution proceedings of the 10th workshop. *pp*, pages 6–14, 2001.

[12] Manal Mohammed Akbar, Nasser Abdul Ali Mansour, and Asmaa Abdul Zahra. *Effect of Aqueous Extracts of Henna Leaves and Olive Pulp on the Life Performance of the Bluebottle Fly (Lucilia sericata).* Calliphoridae, Diptera, 2011.

[13] J. B. Harborne. Phytochemical method. *Chapman and Hull . New York . Is ted*, pp238, 1973.

[14] T. L. Jacobson M. Ladd. and buriff. *C. . Japanese Beetles :Extracts from neem tree seeds as feeding detterents . J.k. Econ . Entomol .*, 71:810–813, 1978.

[15] Suhad Hamid Hassan Shaba'. Effect of fruit extracts of datura innoxia on some aspects of the life performance of the khapra beetle (trogoderma granarium, dermestidae: Coleoptera). *Journal of Kufa University for Life Sciences*, 3(2):186–194, 2011.

[16] Muneef Abdul Mustafa. Toxicity of some iraqi plants on the immature stages of the mosquito culex molestus (forskål) (diptera. Master's thesis, College of Science, University of Mosul, 1989.

[17] T. W. Goodwin and E. I. 1985 Mercer. *Introduction to plant Biochemistry*. Heinemann ltd, Butterworth.

[18] Areej Hassan Salim Al-Zahir. Effect of some plant extracts on the mortality of fourth instar larvae and adults of the mosquito culex pipiens molestus. Master's thesis, Department of Biology, College of Science, University of Basra. 88 pages, 2005.

[19] Hussein Fadel Al-Rubaie, Nihad Kazem Al-Tamimi, and Zahraa Abdul Razzaq Al-Gharbawi. Effectiveness of oil and aqueous extracts of neem (azedirachta indica) and chinaberry (melia azedarach l.) seeds on nymphs and adults of the date palm dubas bug (ommatissus binotatus lybicus de berg). *Iraqi Journal of Agriculture*, 5(3):58–65, 2000.