

Study of the Effectiveness of Using Aqueous Extract of *Coleus Neochilus* Plants in Controlling *Varroa Parasite* (*Varroa Destructor* Oud.) on Honey Bees

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Abstract: Due to the great interest in raising honey bees and their various products in most countries of the world recently, due to their great importance in various agricultural, food, therapeutic, and economic fields, but due to the spread of many honey bee pests, especially the *Varroa* parasite, which led to the death of huge numbers of bee colonies. Therefore, the research aimed to test the efficiency of the aqueous extract of *Coleus neochilus* in controlling *Varroa destructor* instead of using chemicals that pollute the contents of the beehive with chemical toxins that affect humans and the environment in addition to *Varroa* gaining immunity as a result of the repeated use of these materials. Where the experiment was conducted in a private apiary in the isolate of a baker in Nuba village, Al-Odin District, Ibb Governorate, Yemen, on bee colonies of the local strain *Apis mellifera Jamentica* during the period from December 18 to 27, 2020, on standard beehives (Langstroth) with bee colonies of medium strength and to approximately equal degrees (Bee covering about 5 tablets) where three treatments were used 1- *Coleus neochilus* extract 5%, 2- Distilled water with 5% sugar added, 3- Untreated as a control) Sprayed beehives at a rate of 5 sprays on the tires of each cell of the first treatment, while the second treatment sprayed "factory witness" with distilled water with 5% sugar added, and left the third treatment "untreated witness", the first readings were taken after an hour and the other readings after one day. From the treatment for 5 consecutive days, the experiment was conducted between 2 pm and 4 pm to ensure the workers return from the field, The extract of *C. neochilus* 5% was significantly superior to *Varroa destructor* by 84.51% in comparison with distilled water added 5% sugar and untreated control with a percentage of 18.40% and 4.50%, respectively, at $p < 0.05$. The average varroa shedding after an hour compared to the total shedding after a day when using 5% *C. neochilus* extract was about 32.29%, while it was in the control treated with distilled water and sugar 10.33%, significantly superior at $p < 0.01$. The results also indicate that the average percentage of *Varroa* precipitation after and before treatment when using 5% *C. neochilus* plant extract was 33.04 weakness, significantly superior in comparison with the treatment of distilled water added 5% sugar and the untreated control, which amounted to 10.14 and 4.62 weakness, respectively, at the $p < 0.01$.

Keywords: Honey Bee, *Varroa* Bee *Varroa Destructor*, *Coleus Neochilus* Plant Extract, Natural Control

1. Introduction

In addition to its various products (honey, royal jelly, pollen), honey bees play an important role in the pollination of both cultivated and wild plant species. As a result, they actively contribute to the development and conservation of

biodiversity of ecosystems by promoting the sustainability of flowering plants. It is also considered a true biomarker of environmental health [3]. In Yemen, honey bees are considered (*Apis mellifera jemenitica*), which belongs to the

family Apidae, is one of the most beneficial insects, as it produces many useful substances such as honey, royal jelly and pollen. Medical benefits and beekeepers in Yemen face many problems that hinder the development and prosperity of this important branch of agricultural production, where bee pests are considered one of the most important problems facing the Yemeni beekeeper [12]. The Varroa parasite (*Varroa destructor*) is the most dangerous pest directly to beekeeping and thus to the production of crops that require insect pollination [9]. The bee, like other living organisms, has been exposed to numerous pests and diseases during its lifetime, and one of the most common and dangerous pests that severely affect the population and performance of the bee colonies is the *Varroa* mite. This mite belongs to the Varroidae family and *Varroa* genus and feeds on adult larvae hemolymph, pupae, and bees at all stages of life. Mite colony infection causes the bees to lose weight, deform, or lose limbs, and sometimes make young bees die. *Varroa* mite is one of the most important and destructive pests of beehives that causes irreparable damage to the beekeeping industry [11, 16]. *Varroa destructor* is also the main pest of honey bees, as the bee population in *Varroa*-infested colonies is deteriorating significantly [8]. The number of worker honey bees decreases significantly in the affected colonies, which leads to their death if left without control [13]. And the infected colony may die or migrate in addition to the economic losses and the lack of honey production [15]. Many researchers have linked *Varroa* mite infection with the sudden disappearance of honey bees known as the collapse of colonies, and *Varroa* dream also causes the transmission of a number of viral diseases to bee hives [8]. In addition, the *Varroa* parasite transmits diseases through the entry of bacteria and spores of pathogenic fungi and viruses into the virgin honeybee and the adult bee. It also transmits the infection to the healthy virgin by piercing its body and sucking blood from it. [1]. *Varroa* parasite is the main obstacle to the development of beekeeping at the present time, as the adult female parasite absorbs its food from the blood of the adult bee, and when the bee brood becomes available, the parasites leave the adult bee to reproduce inside the cells of the brood feeding on its blood, and when the bees come out of the cells, the mother and her offspring return from adult females to adult bees [2]. Many chemical pesticides were used to control *Varroa*, and the repeated or wrong use of them led to the emergence of resistance in *Varroa* [17]. And contamination of beehive products such as wax, propolis, royal jelly and honey [2, 10]. But recently, many natural products, such as essential oils, have been used as an alternative to chemical products, and these products have shown a high efficacy due to their toxic, repelling and nutritional and developmental inhibition against *Varroa* [7]. *Coleus neochilus* is a powerful and versatile perennial herbaceous plant that is aromatic and when flowering it is visited by bees and other flying insects. This plant is a repellent to snakes, mosquitoes, flies and most garden pests as a result of its aromatic nature, and *Coleus neochilus* is used as an air purifier [19]. it is used in medicine to treat

hepatic insufficiency and indigestion [14]. his plant is widely spread in different regions and governorates in Yemen and some beekeepers use it to paint the walls of beehives before placing the parcels, as it works to stabilize the parcel and its stability in the hive, and it has other benefits as a repellent for pests such as butterflies waworms or *Varroa* parasite, according to their testimony.

The aim of this study:

Because of the spread of a number of pests in the hives of honey bees, especially the parasite *Varroa* which led to the death of huge numbers of bee colonies and the cause of their collapse, In addition to *Varroa* gaining immunity as a result of the repeated use of chemical pesticides that pollute the contents of the beehive with chemical toxins that affect humans and the environment, the research aimed to:

Test the efficiency of the water extract of *Coleus neochilus* in combating *Varroa destructor*.

2. Materials and Methods

2.1. Study Location

The experiment was conducted in a private apiary in the isolate of a baker in the village of Nuba, Al-Odeen District, Ibb Governorate, Yemen, on bee colonies of the local breed *Apis mellifera Jamentica* during the period from December 22 to 27, 2020. On standard hives (Langstroth) with bee colonies of medium strength and of approximately equal degrees (bee coverage is about 5 tablets), screened bottom boards for counting varroa are installed at the bottom of the hives and painted with glycerin paint,

2.2. Ways of Working

In the experiment, hot water extract of 5% of the plant *Coleus neochilus* was used. Some green twigs were collected, which are succulent, With leaves and flowers, they were ground by a mortar and placed (50 g) in a sealed metal container, and in another container 1 liter of hot water was heated to boiling point and then left for 5 minutes before pouring it into the container containing the crushed plant *Coleus neochilus* to preserve the volatile oils After that, hot water was poured over the floured plants, the the bowl was closed tightly, and the mixture was left for 10 minutes, after which the filtering process was carried out by gauze with fine holes to obtain the extract of the plant *Coleus neochilus* [18]. After obtaining the extract, 5% of sugar was added to it and it was filled in opaque glass containers. Distilled water with 5% sugar was also prepared. 12 hives were selected and divided into 3 (treatments), each treatment consisting of 4 standard honeybee hives, and these parameters are:

- 1) The first group: Use a plant extract 5% *Coleus neochilus*.
- 2) The second group: the control treated with water with 5% sugar.
- 3) The third group: a negative witness who is not treated with anything. Rules were placed, counting the fallen varroa, and greased with glycerin (Figure 1) and the tires

were sprayed in a regular manner at a rate of 5 sprays, according to the density of bees for the three treatments (Figure 2) The cells were covered tightly, and the first reading of Varroa stranded on the bases was taken one hour after application and then the second reading was taken one day (24 hours) after application for 5 consecutive days until the effectiveness of the plant extract fades [5].



Figure 1. Varroa counting rule.



Figure 2. The process of spraying bee frames.

Before that, the reading of the natural shedding of dead Varroa was taken naturally for 3 days before the treatment, While the dead varroa shedding reading was taken one hour after treatment and one day (24 hours) and the process was repeated for 5 days until the effect of the plant material faded in order to calculate the average shedding/day. The relative effectiveness is calculated after each day of treatment, where the relative effectiveness in killing Varroa in the experimental and control cells was calculated by applying the following equation: [6].

$$\text{Relative effectiveness} = \frac{\text{Average shedding after treatment} - \text{Average natural shedding before treatment}}{\text{Average shedding after treatment}} \times 100$$

The ratio between the varroa shedding after and before the treatments (double):

It is the number of Varroa shedding times one day after the treatment compared to the average natural precipitation before treatment, and it is calculated as follows:

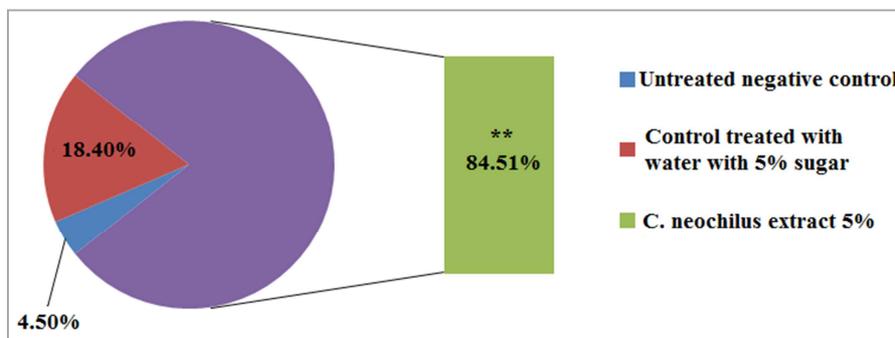
$$\text{The ratio between the natural shedding after and before the application} = \frac{\text{Number of Varroa shedding after 24 hours of treatment}}{\text{average of normal shedding before treatment}}$$

$$\text{The percentage of Varroa shedding after one hour compared to the total shedding after one day} = \frac{\text{Number of Varroa sheds one hour after treatment}}{\text{Total number of Varroa sheds after 24 hours of treatment}} \times 100.$$

2.3. Working Material

Some tools were used in the experiment, such as: smoker - sensitive scales - pieces of sack (made of jute) - magnifying lenses - special bases after Varroa - petroleum jelly - electric mixer - special criteria for estimating bee coverage and brood.

The results were statistically analyzed using the T -test, and the averages were compared with the L.S.D test at the level of probability P = 0.01, P = 0.05 [4].



** There is a significant difference at the probability level. P < 0.01

Figure 3. % Average Relative Effectiveness.

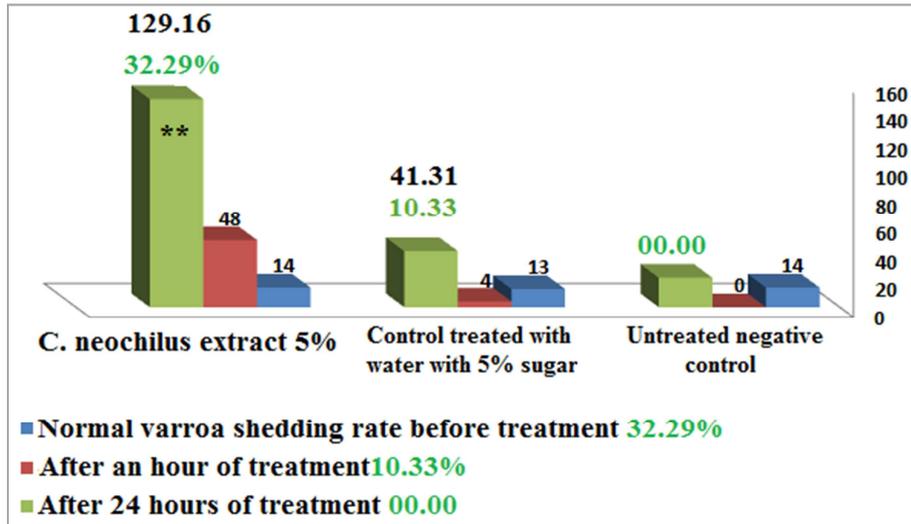
3. Results and Discussion

3.1. Percentage of Relative Effectiveness

The results showed that the use of *C. neochilus* extract 5% in the control of Varroa mite as a spray gave a significant superiority in the mean effectiveness by 84.51% compared to the distilled water 5% sugar and the untreated control, where the average relative effectiveness of them reached 18.40% and 4.50%, respectively, at the level $p < 0.01$ (Figure 3).

3.2. Shedding After 24 Hours

The results of the study indicate that the average varroa shedding after an hour compared to the total shedding after a day (24 hours) when using 5% *C. neochilus* extract was 129.16 with an average of 32.29%, while the ratio between the numbers of Varroa shedding after an hour of treatment compared to shedding after a day (24 hours) 41.31 with an average of 10.33% for the treatment of distilled water 5% sugar at a significant level. $p < 0.01$ as shown in Figure 4.

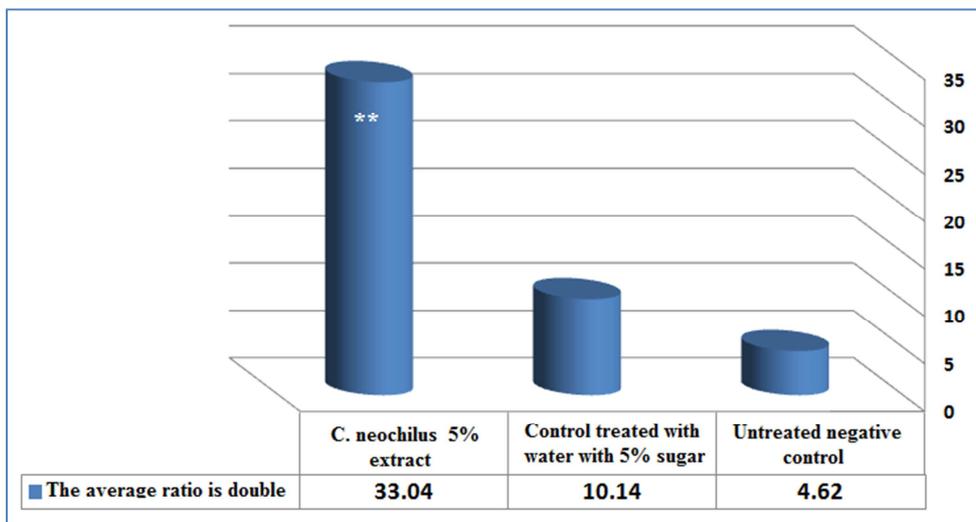


** There is a significant difference at the probability level. $P < 0.01$

Figure 4. The percentage of Varroa shedding after one hour compared to the total shedding after 24 hours.

3.3. The Ratio Between Precipitation After and Before Application (Double)

The results of the study also showed that the use of 5% Coleus neochilus plant extract gave 33.04% double when comparing precipitation after and before treatment, significantly superior to the treatment of distilled water 5% sugar, and the negative control not treated with any substances, where the ratio reached 10.14% double, 4.62% Double straight when level. morale $p < 0$. Figure 5:



** There is a significant difference at the probability level. $P < 0.01$

Figure 5. The average percentage of Varroa shedding before and after application (double).

4. Conclusions and Recommendations

1. The results of the study showed excellent effectiveness of the extract of *Coleus neochilus* through the relative effectiveness of *Varroa* precipitation during the period of application of the study compared to the control treated with distilled water added to it 5% sugar and the untreated control.
2. The reasons for the low numbers of varroa falling are due to the non-proliferation of varroa in bee colonies in the area of the experiment, which coincided with the flowering season of plants (*Euphorbia Cactus*) because its hot nectar reduces the percentage of *Varroa* in beehives, according to beekeepers in the area.
3. The colonies of bees treated with *Coleus neochilus* extract did not show any harmful side effects, during and after the experimental application days.
4. The higher percentage of *Varroa* precipitation in the control treated with distilled water than the untreated control is due to the cleaning behavior of bees.
5. Due to the limited number of experimental bee colonies, only one concentration of *Coleus neochilus* 5% extract was used. We recommend other experiments in which different concentrations are used, to reach the best concentration that gives the highest efficacy of *Varroa* shedding.
6. We recommend the use of *Coleus neochilus* extracts due to its great effect on *Varroa* infestation, and the reduction of the use of chemical products and treatments in order to preserve the quality and reputation of Yemeni honey due to the toxic effects it leaves in bee products, reducing its economic and export value abroad, and also to preserve the health of the local consumer.

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