Special Issue:

Veterinary Medicine between Sustainable Development and Public Health to Confront Global Changes

Effect of Some Plant Extracts on Some Biological Aspects of *Chrysoperla carnea*

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Abstract | Botanical insecticides with quick degradation are safer than persistent synthetic chemical insecticides, less detrimental to the environment, reduce production costs, and are unlikely to induce pesticide resistance in pests. The objective of this study is to assess the effectiveness of the fixed oils derived from the seeds of the *Croton tiglum* and *Simmondsia chinensi*s and the two ethanolic extract (*Urtica dioica* and *Hyoscyamus muticus)* on the lifespan, total protein, fat, and total body carbohydrate of *Chrysoperla carnea (C. carnea)*. The lifespan of *C. carnea* was significantly reduced by all treatments compared to the control group (41.34 days).Fixed oils and ethanolic extracts affected the levels of total protein, fat, and total body carbohydrate. The obtained results concluded that the two fixed oils (*Croton tiglum* and *Simmondsia chinensis*) and the two ethanolic extracts (*Urtica dioica* and *Hyoscyamus muticus*) can be used as safe alternatives to the chemical insecticides.

Keywords: Plant extracts, Chrysoperla carnea, Biological aspects, Biochemical effects

Received | June 02, 2024; **Accepted** | July 20, 2024; **Published** | August 22, 2024
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Citation | Khalaf AFA, Hussein KT, Ali SA, Barakat DA, Gad MI 2024. Effect of some plant extracts on some biological aspects of *Chrysoperla carnea*. Adv. Anim. Vet. Sci. 12(1): 49-54.
DOI | https://dx.doi.org/10.17582/journal.aavs/2024/12.1.49.54
ISSN (Online) | 2307-8316; **ISSN (Print)** | 2309-3331

INTRODUCTION

Chrysoperla carnea is highly renowned predator of insects in several crops and natural environments (Tauber *et al*., 2000; McEwen *et al*., 2001; Medina *et al*., 2003; El-Wakel *et al*., 2013). The hatchlings mostly consume a variety of phytophagous insects such as aphids, Lepidoptera eggs and hatchlings, thrips, psyllids, white flies, and parasites (McEwen *et al*., 2001; Golmohammadi and Hejazi 2014).

Involving of insecticides in controlling aphids prompts few issues, not just expanding safe kinds of aphids to those synthetic compounds yet additionally in enlistment of climate contamination and aggravation of normal equilibrium (El-Maghraby 1993; Ail-Catzim *et al*., 2015). Pesticides have a wide array of harmful effects on human including teratogenic, mutagenic and carcinogenic effects (Prowse *et al*., 2006; Maurya *et al*., 2009).

Organic insect sprays were utilized as option in contrast to engineered insect sprays for insect control in view of its little harmful effects on the human and environment (Behal, 1998; Isman, 2006). Plant extracts are powerful, safe, modest and simple to process and apply for pest control (Isman

2006; Regnault *et al*., 2012). Such plant extracts can cause development delay (Rao and Chitra, 2000), morphogenetic surrenders (Kangade and Zambare, 2013) and repellency (Majeed and Abidunnisa, 2011).

In sight of the previous facts, this study aimed at investigation of how ethanolic extracts of urtica (*Urtica dioica*) and Egyptian henbane (*Hyoscyamus muticus*) could be used instead of regular insecticides to affect different biological aspects of *C. carnea*.

MATERIALS AND METHODS

Rearing of *Chrysoperla carnea*

Rearing of *C. carnea* according to Helaly (2021).

Laboratory experiments: The experiments were carried out under Laboratory conditions 23± 1˚C and 65±5% to study some biological aspects of the predator.

Feeding capacity of *Chrysoperla carnea* larva on aphid *A. gosspyii* treated by plant extracts: Eggs were deposited on their stalks glued on the blak muslin covers, the deposited eggs were collected daily and new black muslin covers were placed. Collected eggs were kept separately in plastic vials 7×2 cm., until hatching. Newly hatched predators larvae *C. carnea* were put individually in a Petri – dish (10cm in diameter) with a filter paper on its bottom. Twenty replicates from *C. carnea* were reared on *A. gossypii*, and treated with plant extracts, two fixed oils (*C. tiglum* and *S. chinensis*) and two ethanolic extract (*U. dioica* and *H. muticus*). Know surplus numbers of aphids offered and the devoured individuals were replaced daily. Attacked prey individuals were counted and recorded daily throughout the periods of the larval instars. Until each larva was transferred to the pupal stage in the spherical silky cocoon date of cocoons formation was recorded. The cocoons were left until adult emergence. Newly emerged adults were sexed and each pair (one male and female) was placed in a glass chimney cage. Eggs laid by mated every female were collected daily, counted and recorded.

Biochemical Studies.

Total proteins determination: Total proteins were determined by the method of (Bradford, 1976).

Total carbohydrates determination: Total carbohydrates were estimated in acid extract of insect by the phenol-sulphuric acid reaction of (Dubois *et al*., 1956). Total carbohydrates were extracted and prepared for assay according to (Crompton and Birt, 1967).

Total lipids determination: Total lipids were estimated by the method of (Knight *et al*., 1972).

Statistical Analysis

Statistical analysis by one way analysis of variance (ANOVA) for significant differences between values, the means were separated using Duncan's Multiple Range Test (CoHort Software, 2004)

RESULTS AND DISCUSSION

Effect of some plant extracts on some biological aspects of *Chrysoperla carnea*.

Durations of Immature Stages

Incubation period: Period of incubation of *C. carnea* eggs that were fed on *A. gossypii* and were given plant extracts had an incubation period of 3.76, 3.5, 3.36, and 3.00 days, respectively, while the control eggs had an incubation period of 3.16 days (Table 1).

Larval stage: The hatchlings of *C. carnea* raised on *A. gossypii* treated by *C. tiglum* the span of first, second and third instars were, 4.33, 5.06 and 7.66 days separately, while, in the event of *S. chinensis* the term of first, second and third instars were, 4.00, 4.70 and 7.20 days, individually, when *C. carnea* hatchlings benefited from *Aphis gossypii*, treated by *U. dioica* these periods were 3.73, 4.60 and 6.73 days, individually. In the event of *H. muticus* these periods were 3.53, 4.30 and 6.66 days, while if there should be an occurrence of *C. carnea* raised on untreated *A. gossypii* the periods were 3.36, 4.13 and 6.36, days separately (Table 1).

Pupal stage: The pupal time of *C. carnea* was recorded when hatchlings of *C. carnea* were benefited from *A. gossypii* treated by four plant extracts and the recorded time was 8.66, 8.06, 7.86 and 7.80, individually.

Total developmental period: When *C. carnea* larvae were fed on *C. tiglum*, *S. chinensis*, *U. dioica*, and *H. muticus*, the total developmental period (from the deposition of the egg until the emergence of the adult) was 25.71, 20.97, 23.46, and 22.29 days, respectively, as shown in Table 1. From this information, obviously the briefest all out formative time of *C. carnea* (21.18 day) was gotten by taking care of the hatchlings on untreated *Aphis gossypii*.

Fecundity and Adults, Longevity of C. carnea in Relation to Larval Food

Table 2, shows the most limited pre-oviposition period of *H. muticus* (5.96 days), yet *U. dioica* recorded 6.13 days and *S. chinensis* was 6.36, while *C. tiglum* was 6.56 days while the control 5.16 days.

Feeding Capacity of *C. carnea* Larvae on *A. gossypii* Treated by Plant Extracts

Results recorded in Table 3, shows the utilization time

Table 1: Durations of *C. carnea* immature stage reared on *A. gossypii* treated with plant extracts under laboratory conditions (23±1°C and 65±5% R.H).

Biological characteristics	Incubation period Mean ±SE	Larval instar			Larval stage Mean ±SE	Pupal stage Mean ±SE	Total immature stages Mean ±SE
		1st instar Mean ±SE	2nd instar Mean ±SE	3rd instar Mean ±SE			
C. tigaium	3.76^{e} ±015	4.33^{e}±0.20	5.06^{e}± 0.16	7.66^{d}±0.20	17.05^{c}±0.53	8.66^{d}±0.24	25.71^{a}±0.44
S. chinesis	3.5^{d}±0.1	4.00^{d}±0.1	4.70^{d}±0.08	7.20^{c}±0.43	15.90^{b}±0.57	8.06^{c}±0.12	20.97^{a}±0.67
U. dioisa	3.36^{d}±0.15	3.73^{d}±0.11	4.60^{d}±0.08	6.73^{c}±0.20	15.06^{b}±0.16	7.86^{c}±0.20	23.47^{a}±0.21
H. mutticus	3.0^{f}±0.1	3.53^{f}±0.15	4.30^{f}±0.16	6.66^{e}±0.20	14.49^{b}±0.28	7.80^{d}±0.21	22.29^{a}±0.45
Control	3.16^{e}±0.21	3.36^{e}±0.21	4.13^{e}±0.20	6.36^{d}±0.36	13.85^{b}±0.12	7.33^{d}±0.16	21.18^{a}±0.20
F.	**6.33	***16.525	***11.87	*5.79	*5.84	**7.34	***11.33
LSD. $_{0.05}$	0.26	0.29	0.33	0.66	1.62	0.44	1.81

Mean followed by the same letter in a column for each plant extracts are not significantly different at the 1% level of probability (Duncan's Multiple Rang Test), **NS:** Non significant; ***:** significant; ****:** Highly significant.

Table 2: Longevity (Mean ± SE.) and fecundity of predators *C. carnea* adults and their larvae reared on different plant extracts under laboratory conditions at (23 ± 1 °C and 65 ± 5 RH %).

Types of extracts	Female longevity				Male longevity Mean ± SE (day)	Female fecundity	
	Pre- oviposition period Mean ± SE(day)	Oviposition period Mean ± SE (day)	Post- oviposition period Mean ± SE (day)	Total Mean ± SE (day)		Daily Mean ± SE (day)	Total Mean ± SE (day)
Control	5.16^{b}±0.30	30.20^{a}±0.74	5.97^{c}±0.49	41.34^{a} ± 1.39	30.3^{a} ±0.86	10.36^{a} ± 0.33	312.84^{a} ± 5.02
C. tiglum	6.56^{a}±0.38	18.96^{d}±1.05	9.52^{a}±0.93	35.05^{c} ± 0.24	24.96^{b} ± 1.23	10.00^{a} ± 0.44	189.83^{d} ± 16.45
S. chinensis	6.36^{a}±0.26	22.53^{c}±1.75	8.50^{ab}±1.01	37.40^{bc}±1.91	28.73^{a}±2.02	9.93^{a}± 0.12	223.69^{c} ± 15.87
U. dioica	6.13^{a}±0.16	25.76^{b}±0.33	7.03^{bc}± 0.12	38.93^{ab} ± 0.37	29.46^{a} ± 0.61	9.60^{a}± 0.08	247.35^{bc}±3.43
H. muticus	5.96^{a}±0.12	27.43^{b}±0.53	6.66^{c}±0.12	40.06^{ab}±0.51	29.4^{a}±0.72	9.86^{a}± 0.24	270.62^{b}±6.90
F	**8.11	***36.91	**9.50	**9.78	**6.002	1.71^{ns}	***35.73
LSD $_{0.05}$	0.59	2.26	1.47	2.45	2.689	0.66	24.56

Mean followed by the same letter in a column for each plant extracts are not significantly different at the 1% level of probability (Duncan's Multiple Rang Test), **NS:** Non significant; ***:** significant; ****:** Highly significant.

Table 3: Mean number *A. gossypii* consumed and percentage from different plant extracts during larval instars of predators *C. carnea* under laboratory conditions (23 ±1 ° C and 65±5 RH. %).

Types of Extract	Larval Instar						Total
	1st		2nd		3rd		Mean ± SE.
	Mean ± SE.	%	Mean ± SE.	%	Mean ± SE.	%	
Control	23.09^{a} ± 3.31	9.15	47.33^{a} ± 1.10	18.91	181.33^{a} ± 16.04	71.92	251.76^{a} ± 17.12
C. tiglum	16.76^{b} ± 0.98	8.10	32.76^{e} ± 1.36	15.83	158.66^{a} ± 2.05	76.22	207.86^{a} ± 10.16
S. chinensis	18.8^{ab} ± 0.36	8.46	38.46^{d} ± 1.30	17.25	165.66^{a} ± 0.93	74.12	223.33^{a} ± 12.70
U. dioica	20.40^{ab} ± 0.80	8.87	41.40^{c} ± 0.74	18.03	168.33^{a} ± 1.36	73.07	230.13^{a} ± 10.53
H. muticus	21.63^{ab} ± 2.06	9.08	44.16^{b} ± 0.98	18.62	172.00^{a} ± 0.85	72.30	237.8^{a} ± 15.16
F	*3.53	0.86^{ns}	***49.01	1.98^{ns}	0.86^{ns}	2.67^{ns}	2.97^{ns}
LSD $_{0.05}$	4.10	1.50	2.50	2.76	28.29	3.32	29.88

Mean followed by the same letter in a column for each plant extracts are not significantly different at the 1% level of probability (Duncan's Multiple Rang Test), **NS:** Non significant; ***:** significant; ****:** Highly significant.

frame pace of *C. carnea* larval instars when reared on *A. gossypii* treated by plant extracts, *C. tiglum*, *S. chinensis*, *U. dioica* and *H. muticus*. A high percentage of 76.22 % of *C. tiglum*, 74.12 % of *S. chinensis*, 73.07 % of *U. dioica*, and 72.30 % of *H. muticus* were consumed during the larval stage, while the first larval instar consumed 8.10, 8.46, 8.87, and 9.08 respectively.

Table 4: Change of total protein, lipid and carbohydrate levels in the third instar of *C. carnea* treated with LC_{50} of the tested compounds for after 48 h.

Treatment	Conc. LC_{50} Ppm.	Total protein		Total lipid		Total carbohydrate	
		µg/mg	%	µg/mg	%	µg/mg	%
C. tiglum	1244.33	25.73^{d}±0.63	-30.94	172.46^{a} ±3.63	54.58	24.26^{e}± 0.54	-27.43
S. chinensis	3584.68	32.36^{b}±1.14	-13.15	143.20^{b} ± 0.81	28.36	28.50^{c} ± 0.48	-14.74
U. dioica	1224.11	28.16^{c}±1.24	-24.42	151.80^{c}± 2.7	36.07	26.3^{0d} ± 0.74	-21.32
H. muticus	2309.26	34.17^{b}±0.60	-8.29	127.73^{d}± 0.81	14.49	30.20 ^{b} ± 0.37	-9.66
Control	____	37.26^{a}±1.11	__	111.56^{e}± 3.63	___	33.43^{a} ± 1.06	__
F	____	***43.08	____	***332.77	____	***52.69	___
LSD	_____	2.22	____	14.01	____	1.76	___

%: Percent decrease or increase from the control.

Biochemical Examinations on the Third Instar of *Chrysoperla carnea*

After 48 hours of treatment with the LC50 of the tested compounds, the biochemical response of the third instar of *C. carnea* was evaluated. The amount of total protein, lipids, and carbohydrates was measured.

The total protein: Data recorded in Table 4, demonstrated that the total protein level of *C. carnea* treated with *C. tiglum*, *S. chinensis*, *U. dioica*, and *H. muticus* decreased by -30.94, -13.15, -24.42, and -8.29% relative to control 37.26, respectively.

The lipid content: The acquired information in Table 4, showed that the total lipid content of a normal insect was 111.56 g of fresh body weight per milliliter, while treatments with *A. gossypii* at sublethal concentrations increased total lipid content by 54.58, 28.36, 36.07, and 14.49 percent for *C. tiglum*, *S. chinensis*, *U. dioica*, and *H. muticus*, respectively.

The total carbohydrates: The data reported in Table 4, showed that the typical degree of complete carb of *C. carnea* was 33.43 µg/mg new body weight, while medicines with the sub-lethal fixations cause decline in the absolute carbs content 24.26, 28.50, 26.30 and 30.20 µg/mg new body weight with decrease percent - 27.45, - 14.74, - 21.32 and - 9.66% for *C. tiglum*, *S. chinensis*, *U. dioica* and *H. muticus*, individually.

The life span of *C. carnea* is shortened by the treatments compared to the control. Our findings align with the research conducted by Saleh and Ali (2012), which demonstrated that the overall consumption rate per *C. carnea* larvae raised on *A. gossypii* was 623.18 ± 41.80. The incubation times of *C. carnea* larvae eggs fed on Aphis gossypii treated with neem, datura, and confidor were found to be 2.2, 2.5, and 3.6 days, respectively, according to research by Ali *et al.* (2015). According to the results, the larvae developed over a total of 17.03, 13.3, and 15.09 days. *C. carnea* pupae lasted 8.82 days on neem, 10.9 days on datura, and 12.33 days on confidor. Conversely, Saleh *et al.* (2017) demonstrated that *C. carnea* larvae fed on A. gossypii developed over a total of 23.8±1.36 days from egg hatching to adult eclosion. A total of 367.31±50.28 of the preys were consumed per *C. carnea* larvae. According to El-Ashram and Salama (2021), there was no discernible difference between the control and *C. carnea* treated with Azadirachtin indica. For example, the incubation period, larval stage, pupal stage, larval survival percentage, and adult survival percentage for *C. carnea* were 2, 8.6, 7.6, 69%, and 70% days, respectively, while for the control, they were 2.33, 8, 8, 80%, and 86.7% days, respectively. When *C. carnea* females fed on A. gossypii and larval instars, Saleh and Ali (2012) reported that the average number of deposited eggs per *C. carnea* female was 327.73 ± 31.19 eggs. Ali *et al.* (2015) demonstrated that neem had the highest pupal mortality rate, followed by confidor and datura on C. carnea pre-oviposited 6.35 days on neem, 5.5 days on datura, and 3.6 days on confidor when feeding on Aphis gossypii treated with neem, datura, and confidor. For neem, datura, and confidor, the maximum fecundity per female of C. carnea was 448.38 days, 435.67 days, and 413.67 days, respectively. Comparably, neem had the highest percentage of *C. carnea* eggs hatching, followed by datura and confidor. On Confidor, however, the highest egg mortality rate of 37.65% was noted. The lowest mortality of larvae in their first, second, and third instars was observed in response to neem leaf extracts, which were followed by datura and confidor. Neem had the highest pupal mortality rate, followed by confidor and datura. Neem had the highest adult death rate, followed by insecticides made of datura and confidor.

According to El-Ashram and Salama (2021), there was no discernible difference between the control and *C. carnea* treated with Azadirachtin indica, with the pre-oviposition, oviposition, and post-oviposition periods being 3.66, 13.66, and 5 days for the former and 7.26, 16.66, and 5.3 days for the latter. In the case of *C. carnea*, each female laid 6.3 eggs, compared to 7.2 eggs in the control group.

Muhammad (2014) showed that the hatchlings of *C. carnea* hunter first instar followed by second and third larval instars were powerful in decreasing aphids' populace on Canola crop. Saleh *et al.* (2017) showed the utilization time frame pace of *C. carnea* larval instars when raised on three prey species; *S. cerealella*, *E. kuehniella* and *A. gossypii*. The typical number consumed during the larval stage were 632.93± 50.26, 444.08±34.40 and 367.31±50.28 of *S. cerealella*, *E. kuehniella* and *A. gossypii* individually consumed a high rate 70.57% of *S. cerelella*, 68.62% of *E. kuehniella* and 69.16% of *A. gossypii* then the main instar hatchlings 4.68%, 5.21% and 5.67% of *S. cerealella*, *E. kuehniella* and *A. gossypii*, separately. El-Wakeil *et al.* (2006) demonstrated that synthetic items were innocuous to grown-up of *C. carnea*. Muhammad *et al.* (2013) expressed that neem oil somewhat protected to beneficial bugs and reasonable for use in coordinated bug the board of aphids with no impact on *C. carnea* in Canola. In a similar vein, Abd-Allah and Youssif (2020) demonstrated that the predator *C. carnea* was unharmed by the active ingredient, cinnamaldehyde, in cinnamon oil. The decrease in all out protein concur with Sammour *et al.* (2011), Shoukry *et al.* (2013) and Gad (2019), who reported that plant extracts decreased protein concentration. Contrariwise a few reports demonstrated that plant separates expanded protein level by Younes *et al.* (2011) demonstrated that onion *Allium cepa*, garlic *Allium sativum*, rosemary *Rosmarinus officinalis* L., olive *Olra europaea*, peppermint *Mentha piperita*, Eucalypyue *Eucalyptus globulus* and sunflower *Helianthus annuus* on the fourth instar hatchlings of *Trogoderma granarium*, caused expansion in protein content than control people. Khalaf *et al.* (2022) concentrated on the impact of five plant oils cumin, dark seed, clove, Ginger and Garlic against biochemical of *Ephestia cautella* and all oils treatment expanded protein level and lipid content while, decrease in the sugar content. The ascent in absolute lipids concurs with the finding of Mostafa (1993), who showed that the complete lipid content in *Trogoderma granarium* expanded because of the treatment with plant extracts. Abou El-Ela *et al.* (1995) found a similar outcome on *Musca domestica* after treatment with water concentrates of certain plants. Few reports demonstrated that plant extracts diminished lipid level as Abo El-Maaty (2003) showed that as *L. pruinosum* and *C. procera* declined the absolute lipids content of the third instar hatchlings of *M. domestica*. The current examinations are equivalent with the findings of Khalaf (1998) who showed that treatment of the second larval instar of *Muscina stabulans* with two plant oils of *Rosmarinus efficinalis* and *Cymbopogon citratus* caused a critical decrease in the carbohydrate content of the entire pupal period and Medhini *et al.* (2012) reasoned that the plant extracts decreased carbohydrate in Spodoptera litturalis.

CONCLUSIONS AND RECOMMENDATIONS

The two fixed oils (*Corton tiglum* and *Simmondsia chinensis*) and the two ethanolic extract (*Urtica dioica* and *Hyoscyamus muticus*) showed significant alterations on the biological activities of *C. carnea* and can be regarded as safe alternatives to the chemical insecticides. Future studies are still needed to find other ecofriendly natural insecticides.

ACKNOWLEDGMENTS

We thank our colleagues at the Department of Zoology, Faculty of Science, Zagazig University, Egypt, and Plant Protection Research Institute, Agricultural Research Center, Egypt for their contributions to the study.

AUTHOR'S CONTRIBUTION

All authors contributed equally in the manuscript.

Conflict of Interest

The authors declare that they have no conflict of interest.

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