The Effect of Feeding *Chrysoperla carnea* Steph Adults with Some Nutritional Diets on Some of its Life and Reproduction Characteristics

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Abstract

Green lacewing predator (*Chrysoperla carnea*) is polyphagous predator. It is currently mass-reared and used in biological control of insect pests. The experiment was carried out under laboratory conditions at 25±2°C and 65±5% RH at Hama Biological Control Center, during 2017, to find out a better and high efficiency nutritional diet for mass-rearing of adult of *C. carnea*. Four adult diets were tested under the laboratory conditions. Fertility, larval period, pupal period and adult longevity were studied. The results showed that the 1st diet that contained of water, honey, yeast and pollen in a ratio of (9:3:1:1) respectively was better than all other diets, that contain a ratio of (1:1:1/ 6:2:1/ 9:3:1) of water, honey and yeast respectively. When the adults fed on 1st diet the fertility of females was 409.33 eggs, larval period was 9.92 days, pupal period was 7.92 days and longevity of female and male were 51.5, 38.5 days.

Key words: Nutritional diets, Adult, *Chrysoperla carnea*.

Introduction:

Biological control is relatively permanent, safe, economical and environmentally friendly. It can be defined as "the action of parasites, parasitoids, predators and pathogens to keep the pest populations at a lower average than the economic injury level (Messina and Sorenon, 2000)". The safety of biological control is outstanding because many natural enemies are host-specific or restricted to a few closely related species. Therefore, the non-target species are not affected. Efficient natural enemies often continue to have a suppressing affect year on insect pests (El-Serafi *et al.*, 2000).

Chrysoperla carnea Stephens (Green lacewing) also known as aphid lion belongs to family Chrysopidae, order Neuroptera. It is found in most of the environments throughout the world. Larvae of *C. carnea* are a voracious predator of exposed eggs, small larvae of beetle and lepidopterous pests. It also feed on slow moving and soft-bodied arthropods such as aphids, jassids, thrips, psyllids, whitefly, scales, mealy bugs and mites (Carrillo *et al.*, 2004; Zaki and Gesraha, 2001; Jloud *et al*., 2013b).

It has been widely used for aphid bio-control (Venkatesan *et al*., 2000, 2002) and other insect because of its ubiquitous nature, polyphagous habits, and compatibility with selected chemical insecticides, microbial agents and amenability to mass rearing (Uddin *et al*., 2005). *C. carnea* is found in different agricultural habitats (Zelany, 1984) in high relative frequency of occurrence (New, 1984).

One larva may devour as many as 500 aphids in its life and there is no doubt that they play an important part in the natural control of many small homopterous pests (Michaud, 2001). It has been mass-reared and marketed commercially in North America and Europe for population management of many pests (Liu and Chen, 2001; Tauber *et al*., 2000). It has broad prey range and effective searching abilities

(Ridgway and Murphey, 1984) and high resistance to many widely used pesticides (Bigler, 1984). Rearing techniques which enable it to produce of large numbers of eggs and larvae needed for inundated release of *C. carnea* have been developed (Tulisalo, 1984). In this study several experiments were conducted to find out the cheaper, more effective and easily available adult diet of green lacewing.

Materials and Methods:

The experiments were conducted at Hama Biological Control Center, Hama, Syria. Experiments were designed according to Randomized Complete Block Design (RCBD) with five replications, each has three pairs of adult *C. carnea*. These adults were kept in glass jars (8x20 cm), jars were covered with black cloth and was tied tightly with rubber band. The different adult diets were provided inside the glass jars with the help of small of plastic strips, each strip contains three points of diet. All diets were provided with the interval of 24 hours. Four different diets were tested. The different ingredients used in all of the diets were well mixed to make them homogeneous; the diets were consisting of following components:

1st Diet: water, honey, yeast and pollen of ratio of (9:3:1:1) respectively.
2nd Diet: water, honey and yeast of ratio of (1:1:1) respectively.
3rd Diet: water, honey and yeast of ratio of (6:2:1) respectively.
4th Diet: water, honey and yeast of ratio of (9:3:1) respectively.

Eggs were laid on the walls of rearing jars and the cloth screens were daily harvested with sharp razor and one egg per Petri dish (10 cm) was placed with the help of soft hair brush. After hatching, the newly hatched larvae were fed on frozen eggs of *E. kuehniella* Zeller which were obtained from laboratory mass-rearing then the eggs were killed by freezing at 2º for 20 days. The experiment was continued until the formation of cocoons, the cocoons formed were removed to other empty glass Petri dish to observe and record the emergence of adults.

The experiment was conducted at 25±2ºC, 60±5 % RH and 16/8 D/L according to Jloud *et al.*, (2013a). The recorded parameters:

1. **Fertility** (number of eggs laid per female).
2. **Larval period**
3. **Pupal period**
4. **Adult longevity**

Statistical analysis:

Data recorded was analyzed using computer software SPSS. Least Significant Difference (LSD) test was used on the level of 0.01 of significance.

Results and Discussion:

1. Fertility:

Feeding of *C. carnea* adults on different diets significantly affected its fertility ($P< 0.001$)**.** The maximum number of eggs laid by female of *C. carnea* was 409.33±15.60 eggs recorded when fed on first artificial diet, whereas, the minimum number of eggs laid by female *C. carnea* was 133.07±7.21 eggs when fed on second artificial diet. It is obvious from Figure (1) that fertility was not significantly different for the females fed on 1st, 3rd and 4th diets but it was significantly higher than 2nd diets.

Our results were better than results found by Ulhaq *et. al*., (2006) where female fertility was 168.30 eggs when fed on egg yolk diet and higher than Sumera *et al.*, (2016) results that was 116.25 eggs when fed on water; honey; yeast of ratio of (10:3:1). But it was less from recorded fertility by Tesfaye *et al*., (2002) that was 1245.2 eggs. As reported by Hill (1989), sugar is a very important component in adult diet for the insects that has pronounced effect on egg production. Similarly, McEwen and Kidd (1995) had recommended yeast and sugar for maximum egg production. Honey is also a very important component regarding fertility, (McEven and Kidd, 1995; Kubota and Shiga, 1995; and Jloud *et al*., 2013a) confirmed that a mixture of honey and yeast autolysis is a suitable adult diet for production of fertile eggs.

Last but not the least component is yolk that is the most important one. Milevoj (1999) reared adults of *C. carnea* on a diet consisting of milk, eggs, fruits sugars and yeast and found a favorable effect on

fertility. Higher fertility observed in diet containing egg yolk because egg yolk rich in protein (amino acids). There are 15.5% amino acids as compared to egg white and mixed egg which contain 9.8% and 11.95% respectively (Norioka *et al.*, 1984).

2. Larval period:

The results indicated that larval period of *C. carnea* adults fed on different adult diets was significantly different (P=0.042). Analysis of the data revealed that total larval period of adults fed on 2nd diet was significantly longer (10.08±0.20 days) as compared to 3rd and 4th diets (9.44±0.21 days) and (9.48±0.16 days) respectively, but it was similar with 1st diet that was (9.92±0.18 days) without significantly difference (Figure 2).

Different scientists had reported that adult and larval diets had reared effect on the larval period of green lacewing. Mishra *et al.*, (1996) and Saminathan *et al.*, (1999) tried different adult and larval diets and concluded that the larval period can be greatly affected by these diets. The results were similar with the results found by Sumera *et al.*, (2016) that total larval period was 8.25 days. Ulhaq *et al*., (2006) found that the larval periods were 13.84, 15.42 and 15.09 days when adults fed on diet containing egg yolk, egg white and mixed egg respectively. Diet containing egg yolk is quite rich in proteins, minerals, vitamins and lipids as compared to the diets containing egg white and mixed egg, which promoted quick growth and quick completion of the larval period (Norioka *et al.*, 1984).

3. Pupal period:

The results that showed in Figure (2) indicated to non-significantly different in pupal periods between different diets (P= 0.442), it was 7.92, 7.64, 7.64 and 8 days, regarding four diets, respectively.

Same results found by Adnan and Khan (2017) and Ulhaq *et al*., (2006), the shorter pupal period of *C. carnea* in the case of feeding on a diet containing egg yolk was due to the rich nutritive value of egg yolk (Norioka *et al.*, 1984), which promoted the quick growth, and completion of pupal period. Cohen and Smith (1998) and Choi *et al.*, (2000) have reported the same results when larvae and adults of *C. carnea* were fed on different types of diets.

4. Longevity (adult life):

Analysis of the data showed that there were significant differences among longevity of female and male lacewings (P< 0.001). The data showed that the longest mean longevity of female and male *C. carnea* were 51.50±1.19 and 38.50±0.70 days respectively, when adults fed on 1st diet comparing with the shortest mean longevity of female and male *C. carnea* that were 31.00±1.00 and 18.40±0.62 days respectively, when fed on 2nd diet (Figure 3). Statistical analysis showed that adults who were fed on diet containing pollen lived significantly longer compared to the adults that were fed on other diets.

The studies showed that different adult diets have significant effects on the longevity of the both male and female of *C. carnea*. McEwen and Kidd (1995) reported that adult life of *C. carnea* is affected directly by the adult diet and found that the adults receiving only sugar as adult diet lived longer than those receiving sugar and yeast (yeast was added to the adult diet for more eggs production). Jloud *et al*., (2013a) found that female and male longevity continue to 63.57, 63.25 days when adult diet contain of water, honey and yeast in ratio of (8:8:1) respectively, while Ulhaq *et al*., (2006) recorded the longest female and male longevity were 29.52, 28.22 days respectively, when adult fed on egg yolk diet.

The adult diet containing egg yolk in addition to milk and honey used in this experiment prolonged adult life probably because of good nutritive value, as egg yolk contains plenty of essential and non-essential amino acids, carbohydrates, oils, vitamins, and minerals (Ulhaq *et al*., 2006). Adult

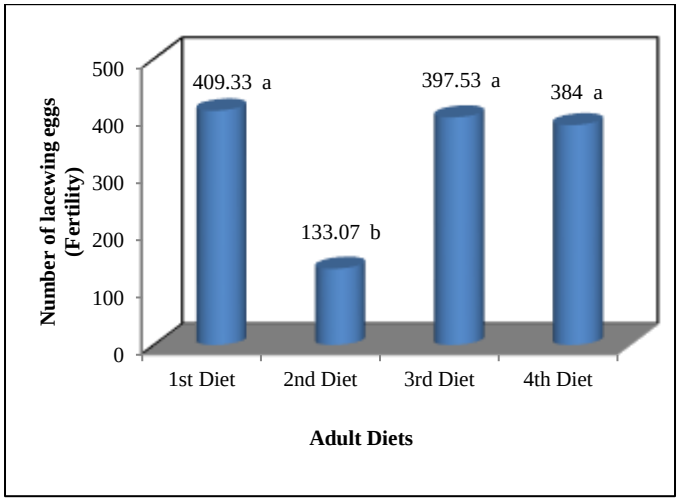

Figure 1. The effect of different adult diets on the fertility of *C. carnea*.

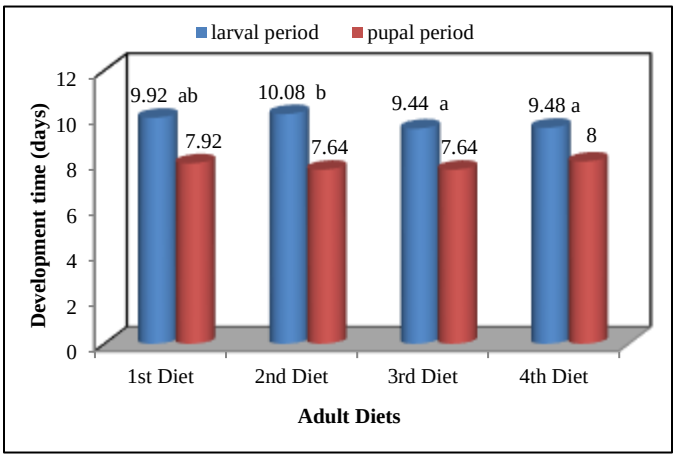

Figure 2. The effect of different adult diets on the larval period of *C. carnea*.

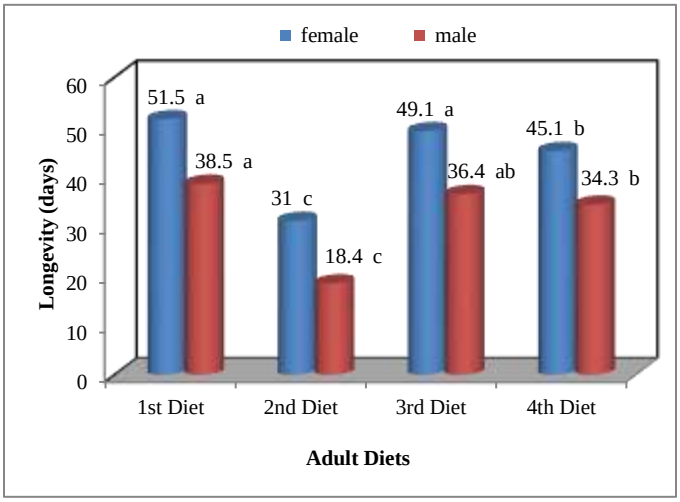

Figure 3. The effect of different adult diets on the longevity of male *C. carnea*.

Conclusions:

The results showed that the 1st diet that contained of water, honey, yeast and pollen in a ratio of (9:3:1:1) respectively was better than all other diets. When the adults fed on 1st diet the fertility of

females was 409.33 eggs, larval period was 9.92 days, pupal period was 7.92 days and longevity of female and male were 51.5, 38.5 days

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دراسة تأثير تغذية بالغات المفترس أسد المن *Chrysoperla carnea* على خلطات غذائية في بعض صفاته الحياتية والتكاثرية

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الملخص

تعتبر حشرات أسد المن من المفترسات متعددة الفرائس. وقد تم تربيتها بشكلٍ كمّي واستخدامها في المكافحة الحيوية للعديد من الآفات الحشرية الضارة. تمّ تنفيذ هذا البحث ضمن ظروف مخبرية (حرارة 25±2° ورطوبة 65±5%)، في مركز المكافحة الحيوية في حماه خلال العام 2017. وذلك لإيجاد أفضل خلطة غذائية وأعلاها تأثيراً في التربية الكمية لبالغات المفترس أسد المن. حيث تم اختبار 4 خلطات غذائية ضمن الظروف سابقة الذكر، ودراسة تأثيرها في خصوبة الإناث وفي مدّة تطوّر يرقات وعذارى وبالغات المفترس أسد المن. أظهرت النتائج أن الخلطة الأولى التي تحتوي على الماء والعسل والخميرة وحبوب اللقاح بنسبة (1:1:3:9) على التوالي، وكانت الأفضل من بقية الخلطات الثلاثة الباقية التي تحوي على الماء والعسل والخميرة على التوالي وفق النسب (1:1:1/ 1:2:6/ 1:3:9)، وأعطت أعلى النتائج. فكانت عندها خصوبة إناث المفترس 409.33 بيضة/أنثى، وبلغت مدّة الطور اليرقي وطور العذراء 9.92 و7.92 يوماً على التوالي. وبلغ طول عمر البالغات المؤنثة والمذكرة للمفترس 51.5 و38.5 يوماً.

الكلمات المفتاحية: خلطة غذائية، بالغات، أسد المن.