

Original Research Article

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Effect of Honey and Sucrose on Longevity of Larval Endoparasitoids Viz., *Glyptapanteles agamemnonis* (Wilkinson) and *Meteorus pulchricornis* (Wesmael)

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The effect of various diets on longevity of *Glyptapanteles agamemnonis* and *Meteorus pulchricornis*, endoparasitoids of *S. obliqua* (Walker) were studied in the laboratory. Our results showed significant difference ($p < 0.05$) in the longevity of *G. agamemnonis* and *M. pulchricornis* when fed on different diets. The parasitoid lived significantly longer when fed on 20% honey solution as compared to 20% sucrose and Honey-Sucrose Solution. Nonetheless, longevity of parasitoid females who fed on 20% honey solution live longer as compared to those fed on 20% Sucrose solution, difference being non-significant. Overall, result showed that 20% honey was a more suitable diet for both parasitoid females' viz. *G. agamemnonis* and *M. pulchricornis* as compared to other diets.

Introduction

The bihar hairy caterpillar, *Spilosoma* (= *Spilarctia*) *obliqua* (Walker) (Arctiidae: Lepidoptera), is a serious pest with a wide host range of as many as 126 species belonging to 24 plant families in India. The gregarious feeding habit of early instars and voracious feeding nature of late instars of *S. obliqua* inflicts damage to a number of plants particularly, pulse, oilseed and fibre crops like jute etc (Goel *et al.*, 2004; Parui and Roy, 2016). During the past decades, pest control

strategy to manage this insect pest was dominated by chemical insecticides creates complex biological and environmental problems. Moreover, the availability of many of the older, broad-spectrum chemical pesticides is declining as a result of the evolution of resistances (Ishtiaq *et al.*, 2012) and legislation (Chandler *et al.*, 2011). Thus, there is an urgent need to develop eco-friendly pest management tactics alternative to chemical insecticide for suppression of this pest.

Biological control with natural enemies has been increasingly followed due to economical, social and ecological problems with insecticides. The braconid parasitoids viz, *Glyptapanteles agamemnonis* (Wilkinson) (Hymenoptera: Braconidae) and *Meteorus pulchricornis* (Hymenoptera: Braconidae) are most crucial parasitoids which regulate the population of *Spilosoma* (= *Spilarctia*) *obliqua* (Walker) (Arctiidae: Lepidoptera) which is a serious pest in India (Gupta and Narendran, 2007). At present, parasitoids are being evaluated to manage early instars of *S. obliqua* (Varatharajan *et al.*, 2006). Although, parasitoids are important determinants of their host's population dynamics and structure, their effective integration into pest management programs depends on a series of factors (Briggs and Godfray 1995). Diet is one of the most common factors that influence the parasitoid biological and reproductive traits and lack of suitable food sources is important constraint to the success of biological control agents as the successful growth, development and reproduction of insects obviously depend on their nutrition, the attainment of their qualitative and quantitative requirements. Generally, the natural foods such as the nectar of beneficial plants are the best diets for parasitoid growth and development. Basri *et al* (1999) found that the longevity of *A. metesae* fed on flower nectar of the *Cassia cobanensis* (Britton) Lundell, a plant that can be easily found in oil palm plantation was significantly longer than *A. metesae* fed on diluted honey, or on other plants nectar such as *Crotalaria usaramoensis*, *Euphorbia heterophylla*, *Euphorbia hirta*, *Asystasia intrusa*, *Hedyotis corymbosa*, *Cleome ruidosperma*, *Ageratum conyzoides* and *Hedyotis verticellata*. Moreover, in the field, parasitoids can rely on different hosts and non-host nutrient sources, such as floral and extra floral nectar, hemipteran honeydew and pollen while artificial diets have been used in mass rearing.

The provision of supplementary foods for adult natural enemies in the habitat is of paramount importance in their distribution, manipulation and effectiveness as the natural foods for parasitoids are not always available. If available, they may have to invest considerably more time in locating food sources if food sites are located outside of the host habitat and food quantity per site is limited (Idris and Grafius, 1995; Temerak, 1983; Barbehenn *et al.*, 1999). The artificial diets can also increase parasitoid longevity at a maximum level when provided with suitable concentrations (Idris and Grafius, 1995). Yu *et al* (1984) reported that feeding honey to female *T. chilonis* increased their fecundity 6-fold and their longevity 9-fold over unfed wasps. The development of artificial diets on which insects can be reared in a laboratory has allowed researchers to determine the nutrient necessary to support the growth and reproduction of numerous species (Barbehenn *et al.*, 1999). Therefore, the present study was planned to investigate the “Effect of honey and sucrose on longevity of larval endoparasitoids viz, *Glyptapanteles agamemnonis* (Wilkinson) and *Meteorus pulchricornis* (Wesmael)”

Materials and Methods

Rearing of host insects

Bihar hairy caterpillar *Spilosoma (Spilarctia) obliqua* (walker)

Nucleus culture of *S. obliqua* was established in the laboratory by collecting the adults in light trap during August, 2011 at SKUAST- J, FOA- Chatha. These adults were kept in glass jars (50×30 cm diameter) lined with filter paper and covered with muslin cloth. The moths were fed upon 10 per cent sucrose solution and allowed to mate for egg laying on glass surface or paper. Eggs obtained from these adults were kept in petriplate. The

neonate larvae were collected after hatching and fed on tender wild castor leaves for further rearing. Castor leaves were previously washed and air dried before being fed to larvae. Uneaten food along with faeces was removed regularly in order to maintain hygiene in the rearing containers. The feed was changed daily and rearing space was increased regularly by using more number of jars for avoiding overcrowding of the larvae for promoting uniform growth and development of the larvae. The colony was reared at temperature of $26 \pm 2^{\circ}\text{C}$ and $70 \pm 10\%$ RH and L: D (16:8) photoperiod.

Rearing of parasitoids

Parasitoids which were used in this study viz., *Glyptapanteles agamemnonis* and *Meteorus pulchricornis* were initially collected from field and served as nucleus culture. The nucleus culture of both parasitoids was established in the laboratory on laboratory reared larvae of *S. obliqua* maintained separately in laboratory. These laboratory reared larvae were parasitized with the parasitoids that were collected from the field and after parasitisation; these larvae were kept in glass jars (50×30 cm diameter) covered with muslin cloth. These larvae were reared on tender castor leaves until the parasitoids emerged. The respective parasitoids that emerged from the host body formed cocoons. The newly formed cocoons were collected, harvested and placed in glass jars (20×15 cm) covered with muslin cloth till emergence. Muslin cloth was plugged with cotton plug at the centre. Upon emergence, adult parasitoids were transferred into separate test tubes (5 × 2 cm) with the help of aspirator for further experiments.

Effect of honey and sucrose on longevity of parasitoids

To determine the longevity of parasitoids, a batch of 20 newly emerged female adult

parasitoids, *Glyptapanteles agamemnonis* and *Meteorus pulchricornis* were placed in glass jars (20 × 15 cm) covered with muslin cloth plugged with cotton plug at the centre. The parasitoid adults of *G. agamemnonis* were fed with 3 different treatments (diets) immediately after emergence: 20% Sucrose solution, 20% Honey solution and Honey-Sucrose Solution. Similar procedure was followed with *M. pulchricornis*.

Statistical analysis

All the observations recorded were analyzed by using statistical package (SPSS 16).

Effect of honey and sucrose on longevity of Parasitoids was subjected to ANOVA followed by Tukey's post hoc test for comparison of means.

Results and Discussion

The results obtained during the present investigation entitled "Effect of honey and sucrose on longevity of larval endoparasitoids viz, *Glyptapanteles agamemnonis* (Wilkinson) and *Meteorus pulchricornis* (Wesmael)" are presented as under:-

Effect of honey and sucrose on Longevity of *Glyptapanteles agamemnonis*

There was a significant difference in longevity of *Glyptapanteles agamemnonis* ($F = 9.49$, $df = 2, 57$, $p = 0.000$) when fed on various diets concentrations. The parasitoid lived significantly longer when fed on 20% honey (4.50 ± 0.22) than fed on 20% sucrose (4.15 ± 0.18) and Honey-Sucrose Solution (3.30 ± 0.19). Parasitoid females fed on 20% honey and 20% sucrose lived significantly longer than those fed on Honey-Sucrose Solution. However, longevity of the parasitoids was not significantly different when fed on 20% honey solution or 20% Sucrose solution. Although parasitoids fed on 20% honey solution live

longer as compared to those fed on 20% Sucrose solution (Table 1) (Fig. 1)

Effect of honey and sucrose on Longevity of *Meteorus pulchricornis*

Significant difference in longevity of *Meteorus pulchricornis* (F = 18.74, df = 2, 57, p = 0.000) were observed when fed on different artificial diets. The adult females of *M. pulchricornis* lived significantly longer

when fed on honey solution (4.90 ± 0.21) followed by sucrose solution (4.65 ±0.22) and honey-sucrose solution (3.25 ±0.17). Although, Longevity of the female parasitoids fed on 20% honey solution was slightly longer than those fed on 20% Sucrose solution. However, the difference was not significant. Further, Parasitoid females fed on 20% honey and 20% sucrose lived significantly longer than those fed on Honey-Sucrose Solution (Table 2) (Fig. 1).

Table.1 Effect of honey and sucrose on Longevity of *Glyptapanteles agamemnonis*

S. No	Treatment	Longevity
1	20% Honey solution	4.50 ± 0.22b
2	20% Sucrose solution	4.15 ±0.18b
3	Honey-Sucrose Solution	3.30 ±0.19a

Values are Means ± SE

Means with in a column followed by different letters are significantly different P<0.05

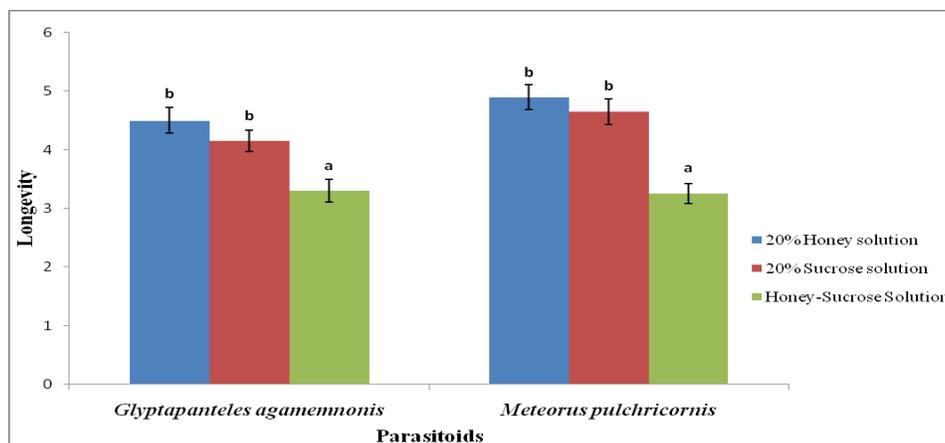
Table.2 Effect of honey and sucrose on Longevity of *Meteorus pulchricornis*

S. No	Treatment	Longevity
1	20% Honey solution	4.90 ± 0.21b
2	20% Sucrose solution	4.65 ±0.22b
3	Honey-Sucrose Solution	3.25 ±0.17a

Values are Means ± SE

Means with in a column followed by different letters are significantly different P<0.05

Figure.1 Effect of honey and sucrose on longevity of parasitoids



Means with in a series followed by same letters differ significantly (ANOVA, Tukey's HSD; P<0.05)

Although the longevity of *G. agagemmonis* and *M. pulchricornis* females fed on 20% honey and 20% sucrose solutions was not significantly different but the parasitoid survived relatively longer when fed on 20% honey than fed on 20% sucrose solution. This was attributed to the proteins, vitamins and sugar present in honey and sucrose which seems to be adequate for the nourishment of the parasitoids which in turn increases the longevity of parasitoids. Although the longevity of parasitoid females fed on 20% honey and 20% sucrose solutions was not significantly different. However, the parasitoids lives relatively longer when fed on 20% honey than fed on 20% sucrose solution. These results find support from earlier findings of Shaw (1997) who stated that honey is an excellent diet for parasitic wasps as it is for bees. Many other researchers also reported that almost all parasitoid species had lived longer when provided with honey solution than sucrose. Similarly, Saljoqi *et al.*, (2007) reported that the adult females *T. chilonis* lived significantly longer when provided with 50% honey, than those provided with any other feed or remain unfed. Temerak (1983) reported honey solution provided to female *Bracon brevicornis* (Hymenoptera: Braconidae) as the most suitable diet as compared with 10% sucrose. Similarly, Leatemia *et al* (1995) reported that the longevity of honey-fed *T. minutum* was 26.4 days compared with 23 days and 21 days when fed on 50% fructose and 20% sucrose respectively.. Similar results were reported by Mitsunaga *et al.*, 2004 which showed that the *Cotesia plutellae* (Hymenoptera: Braconidae) females had better longevity when fed with 50% honey compared with 20% sucrose although there was no difference in longevity of male wasps. But in contrast, Vatansever and Ulusoy, 2009 reported that the lifespan of parasitoid *Cales noacki* (Hymenoptera: Aphelinidae) was better when fed on sugar water (10%) than fed on honey water (10%).

Significant decrease in longevity was reported when parasitoids were fed with honey-sucrose solution. This indicated that both honey and sucrose were better diet for both *G. agagemmonis* and *M. pulchricornis* as compared to honey-sucrose solution. Higher concentration of sugar contains more energy and too much energy or lack of water which will shorten the parasitoid longevity. These results find support from Barbehenn *et al.*, 1999 who also reported that too much energy shortens the parasitoid longevity. Salmah *et al.*, 2012 who revealed significant difference in the longevity of *Apanteles metesae* when fed on various concentrations of honey solutions. Longevity of *A. metesae* was significantly longer when fed on 50% honey than on pure honey. Nonetheless, longevity of *A. metesae* females fed on 50% honey was relatively longer than other honey concentrations. The parasitoid lived significantly longer when fed on 20% sucrose than 50% sucrose and distilled water. However, the parasitoid fed on 50% honey had a longevity that was statistically similar to 20% sucrose and 50% sucrose. Overall, the result showed that 20% sucrose was a more suitable diet for *A. metesae* females as compared with other diets. The results obtained from this study can be useful for mass rearing of *G. agagemmonis* and *M. pulchricornis* and can be incorporated in biological control program of *S. obliqua* in the future.

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