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Effect of adult nutrition on longevity and fecundity of *Dinarmus basalis* (Rond.) (Hymenoptera: Pteromalidae)

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ABSTRACT: The role of adult nutrition on longevity and fecundity of *Dinarmus basalis* was examined. There were significant differences in longevity and egg production on different diets (P < 0.001). On an average, body fluid-fed females of *D. basalis* lived for 26.6 days and produced 392.8 eggs; virgin females lived for 27.95 days, but produced 362.75 eggs. Honey-fed females lived a maximum of 31.2 days but produced 368.3 eggs than body fluid-fed *D. basalis* whereas glucose-fed females lived for 26.75 days and produced 312.6 eggs. Longevity and fecundity of females of *D. basalis* fed on sucrose and distilled water was more or less the same (distilled water, 20.35 days and 247.15 eggs; sucrose, 21.15 days and 265.9 eggs). The minimum longevity and fecundity were observed for lactose-fed females (17.45 days and 172.0 eggs). A significant relationship between total production of eggs and total longevity of females (r = 0.914 and b = 14.77, P<0.001) was noticed.

KEY WORDS: Adult nutrition, *Callosobruchus chinensis*, *Dinarmus basalis*, ectoparasitoid, fecundity, longevity

Callosobruchus chinensis (L.) (Coleoptera: Bruchidae) is one of the most destructive pests of stored pulses. The infested seeds become unfit for consumption and lose their viability (Lal, 1993). There is loss of carbohydrate, fatty acids, protein content and free amino acids (El-Zemaity *et al.*, 1985). This pest multiplies rapidly in warm conditions and inflicts serious damage within short time. Six months after the initial infestation, 100 per cent of the pulses become infested and the weight loss may rise up to 48.9 per cent in case of gram under laboratory conditions (Singh, 1965). Loss in weight of lentil after 3 months by releasing 50 beetles of *C. chinensis* in 100g seed was 14 per cent (Rajak and Pandey, 1965).

Dinarmus basalis (Rond.) is a cosmopolitan ectoparasitoid of larval, pre-pupal and pupal stages of the pulse beetle, *C. chinensis*, that develops inside kernels of stored lentil, *Lens esculentus* L. (Southgate, 1979; Islam *et al.*, 1985). This parasitoid has only recently attracted attention as a biological control agent (Islam and Kabir, 1995) of *C. chinensis*.

Parasitic wasps generally require food both for the production and maturation of eggs and as an energy source for flight. Parasitoids need nutritive compounds similar to other insects, e.g., amino acids, vitamins, minerals, cholesterol and a hexose monosaccharide (House, 1977).

No information is available on the longevity and fecundity of *D. basalis* on different food sources. The aim of this study was to determine the effect of different food sources on the longevity and fecundity in *D. basalis*, which may lead to a better understanding of the role of nutrition in the life of the parasitoid. The idea of manipulating food sources to increase fecundity and longevity of the parasitoid may be helpful in planning biological control against target insect pests.

MATERIALS AND METHODS

Mated females of *C. chinensis* were kept in large Petri-dishes (11.5cm diam) with fresh red lentil, for 2h for egg laying. The deposited eggs were placed in an incubator at 30 ± 1°C for 12-15 days for post-embryonic development and then were used for the experiment.

Callosobruchus chinensis infested seeds oviposited by *D. basalis* were collected from the culture and kept in different glass vials and subsequent mating was observed after adult emergence. In case of virgin females no mating was performed. The adult diets, namely, host (*C. chinensis*), aqueous solutions of honey, glucose, sucrose, lactose and distilled water were tested.

Each female was supplied with 50 *C. chinensis* infested seeds having 12-15 days old *C. chinensis* in different Petri-dishes (8.5cm diam). Food items were provided on a piece of polythene strip that was changed every 24h.

All Petri-dishes were kept in an incubator (30 ± 1°C) and at every 24h interval the seeds were replaced by fresh infested seeds. This procedure was repeated until all the female parasitoids died. Longevity of the females was noted. The seeds with parasitized hosts were dissected and the total number of eggs deposited was counted daily in each treatment. Two lots were supplied with only live host (*C. chinensis*) as food for mated and virgin females of *D. basalis* to see the host-feeding. Data were obtained for five individual females from each diet and were replicated four times. The data were subjected to analyses of variance and regression.

RESULTS AND DISCUSSION

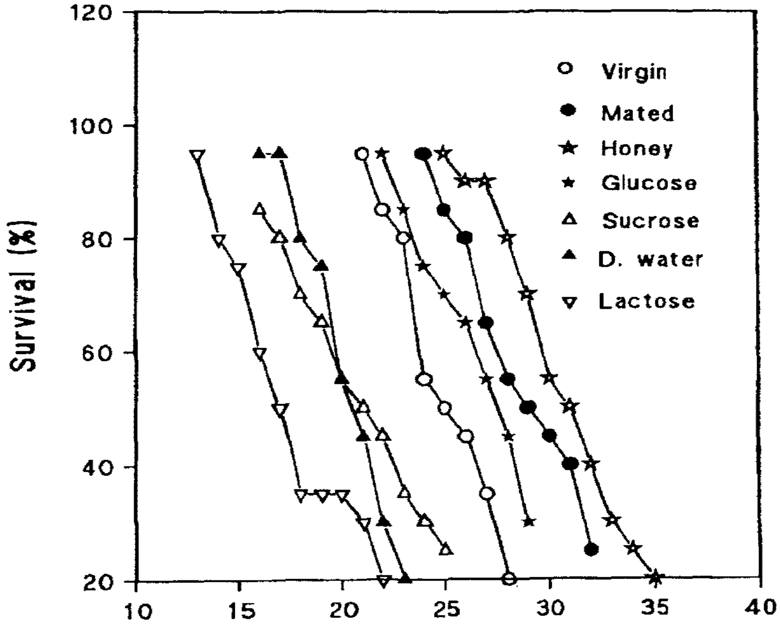
In the present study it has been found that the female *D. basalis* penetrates its sharp and pointed ovipositor through the outer surface of the host. After oviposition the female withdraws the ovipositor from the seed and again inserts the ovipositor to form a feeding tube extending from the surface of the body of the host to outside the seed. She feeds on the hosts' fluid that oozes out through the feeding tube. It is believed that this food significantly increases the number of mature eggs in the ovaries. Formation of feeding tube in a similar way in other pteromalid parasitoids has also been described (Edwards, 1954; Gerling and Legner, 1968).

A significant difference was noticed on longevity in *D. basalis* when fed on different diets ($P<0.001$). The per cent survival of females of *D. basalis* on different diets are presented in Fig 1. The survival was greater on honey followed by fluids of *C. chinensis* virgin, mated, glucose, sucrose, distilled water and lactose-fed females.

Results of the daily mean number of eggs produced by female *D. basalis* on different diets are presented in Fig 2. The egg production on different diets was highly significant ($P < 0.001$). Mated females produced more eggs in their lifetime per day than virgin females, which sucked fluids of *C. chinensis*. The order of egg production was host fluid>honey> glucose> sucrose>distilled water>lactose.

On the first day, mean number of eggs laid by a mated *C. chinensis* feeding female of *D. basalis* was 18.15 ± 0.37 (Fig. 2). Oviposition reached its peak on the 5th or 6th day after which there was a decline. The rate increased again from the 17th to the 19th day. Egg production gradually decreased thereafter until death.

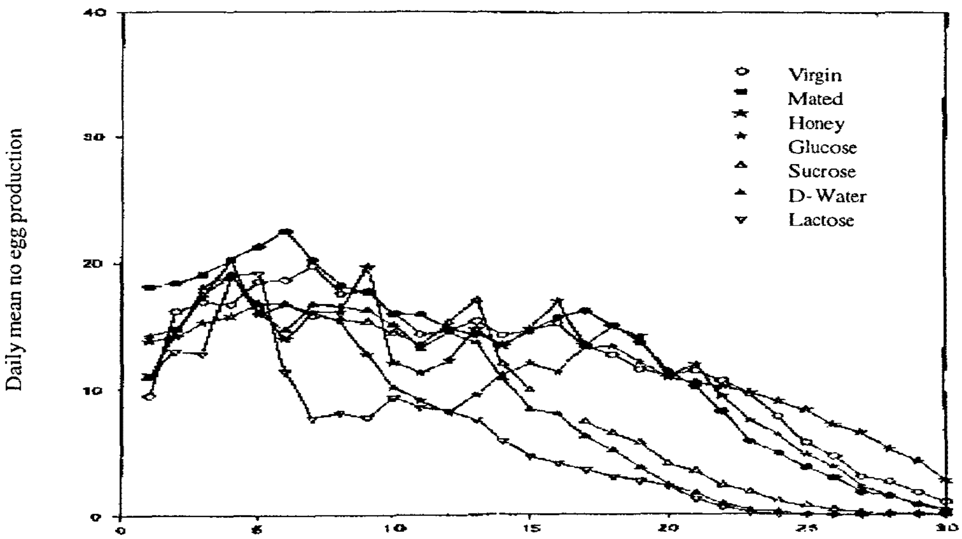
The virgin females of *D. basalis* also



Age of Females (Days)

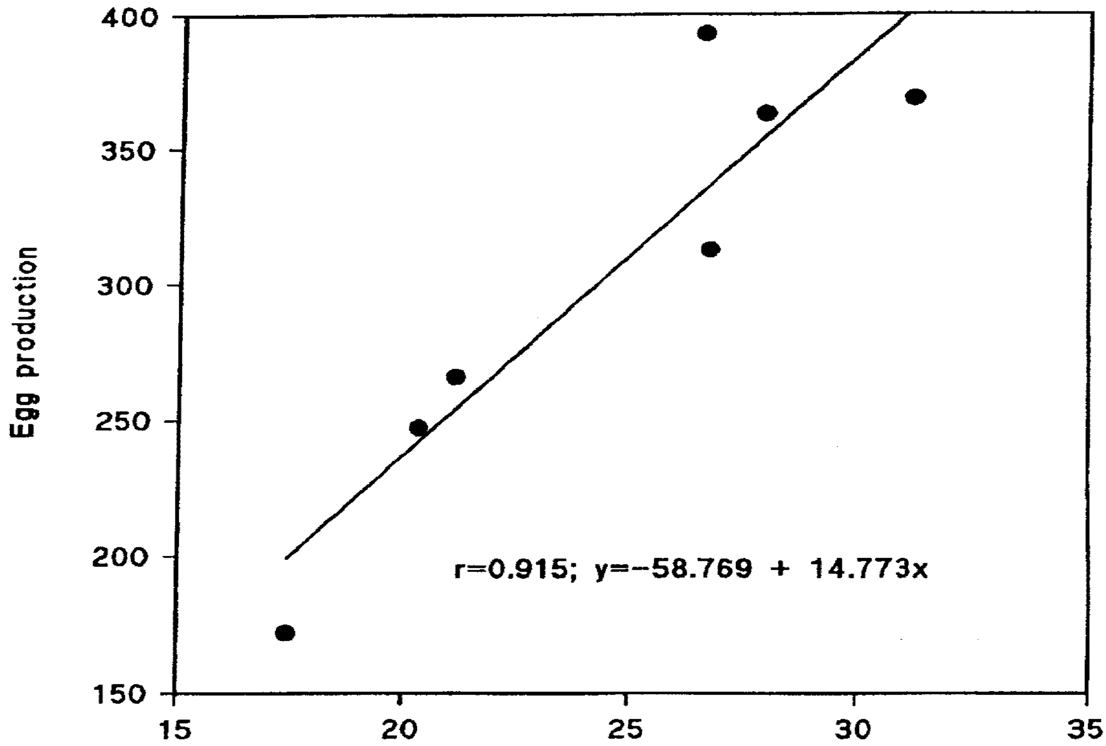
Fig 1. Per cent survival of females fed on different diets

consumed fluids of *C. chinensis* and produced lesser number of eggs per day at the beginning (Fig 1). On the first day, the mean number of eggs produced by a virgin female was only 9.5 ± 0.34. Egg production progressively increased from 5th to 10th day and it was maximum on the 7th day



Age of Females (Days)

Fig 2. Daily Egg production of *D. basalis* on different diets



Age of Females (Days)

Fig 3. Relation between ovipositing age of females and total production of eggs

(19.8 ± 0.19). From 11th to 18th day they produced more or less constant number of eggs and then gradually the oviposition rate declined.

When honey was provided to the females they produced more or less an equal number of eggs per day from the 1st to 3rd day and then egg production gradually increased. The maximum number of eggs was laid on the 9th day. The production of eggs gradually declined when *D. basalis* was fed on glucose. It laid an equal number of eggs per day from 1st to 8th day and the peak oviposition was recorded on the 14th day (20.25 ± 0.35/female). Again, the egg production progressively increased from 15th to 19th day and gradually decreased, thereafter. The maximum number of eggs was produced on the 4th day (19 ± 0.23/female) when fed on sucrose. The peak oviposition was observed for distilled water fed *D. basalis* on the 4th day (19.15 ± 0.3/female). The minimum number of eggs were produced when the females were fed on lactose and the peak oviposition occurred on the 5th day (19.2 ± 0.3/ female).

Mean number of eggs produced by *D. basalis* when fed on different diets in their lifetime are presented in Fig 3. Host-feeding females produced 392.8 ± 12.97 (range: 269 – 471) followed by host-feeding virgin females 362.75 ± 6.55 (range: 312 – 421), honey 368.3 ± 7.28 (range: 328 – 446), glucose 312.6 ± 7.02 (range: 248 – 362), sucrose 265.9 ± 9.77 (range: 187 – 338), distilled water 247.15 ± 4.61 (range: 208 – 279) and lactose 172.0 ± 8.19 (range: 127 – 251).

There was a linear relation between the age of ovipositing females and the total egg production (Fig 3.). *D. basalis* exhibited significant production of eggs in their lifetime. The production of eggs was positively correlated with the longevity of ovipositing females. When the longevity of females increases, production of eggs also increases.

Most parasitic Hymenoptera termed as 'synovigenic' continue to produce eggs throughout the adult life (Flanders, 1950). In such cases the production of eggs and duration of the life of imago are dependent on the nutrition of the females rather than on the metabolites retained from the immature host stages. *D. basalis* being synovigenic produced eggs throughout the adult life. The sequence of egg-production is cyclic and not linear.

Pteromalids have a variable range of egg laying capability per day depending on the availability and suitability of hosts and the prevailing environmental conditions. In the present study, a maximum of 25 (range: 1-25) eggs/day by a single mated female and 20 (range: 1-20) eggs/day by a virgin female, 22 (range: 1-22) eggs/day by a honey fed female, 19 (range: 1-19) eggs/day by a glucose fed female, 18 (range: 1-18) eggs/day by a lactose fed female, 17(range: 1-17) eggs/day by a sucrose fed female and 16 (range: 1-16) eggs/day by a distilled water fed female have been recorded. Daily production of eggs in other pteromalid parasitoids has been reported as 20-30 eggs/female in *Pachycrepoideus vindemmiae* Rondani (Nostvik, 1964) and 21 in *Amblymerus bruchophagi* (Saunders and Hsiao, 1970).

Patana (1979) observed that *Brachymeria ovata* (Say) produced the highest number of eggs and lived longer when fed on the host, *Heliothis virescens* (F.). Timerak (1983) investigated the life-span of adult *Bracon brevicornis* Wesm. On various types of foods or the absence of foods, and found that when provided with artificial diets (sucrose, molasses, honey or tap water), the female lived the longest on honey solution.

Considering all the foods, it may be concluded that body fluids of *C. chinensis* proved to be the best for its egg production and honey solution for survivability in *D. basalis*.

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