Mass Production of Rice Meal Moth (*Corcyra cephalonica*) on Different Food Media Under Laboratory Conditions

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Abstract

Considering the potential of *Corcyra cephaionica* as a host for mass rearing of some egg parasitoids, the present research was undertaken to study the development of *Corcyra cephaionica* on different food media with a view to find out suitable food(s) for this purpose. Three different food media *viz.* wheat flour, maize flour and mixture of wheat & maize flour (1:1) were used for the development of rice meal moth, *Corcyra cephalonica* (Stainton). Average number of eggs laid was found to be highest (230.67/female) in maize flour but hatching was found highest in wheat flour (86.87%). Longest and shortest larval duration were 43.17 and 29.90 hours when reared on maize flour and wheat flour, respectively. The highest (71.50%) and lowest (43%) larval survival rates were found on wheat flour and maize flour respectively whereas highest survival rate of pupae followed the same trend 76.34% and 49.58% on wheat flour and maize flour, respectively. The current study and results revealed that wheat flour could be used as best food for the development of *Corcyra cephalonica.*

Keywords: Development, food media, *Corcyra cephalonica*, survival rate, parasitoid

Introduction

Corcyra cephalonica commonly called as rice meal moth or rice moth is a pest of stored foods, *viz.*, cereals, cereal products, oilseeds, pulses, dried fruits, nuts and spices. Many of the natural enemies mass-bred in the laboratory for use in field against crop pests are dependent on either egg or larval stages of *Corcyra* as it is easier and cheaper to produce natural enemies on different stages of *Corcyra* than on their original hosts. The rice meal moth, *Corcyra cephalonica* (Stainton) is a destructive insect and infests rice, wheat, maize and some other leguminous crops (Malek and Parveen, 1989). The larvae alone damage the stored grains by feeding under silken webs (Alam, 1972). During high infestation, the entire stock of grains may be converted into a webbed mass developing a characteristic bad smell and renders it unfit for human consumption (Alam, 1965). Moore *et al*., (1966) reported that a single larva consumed an average of 32.9 mg that results to a loss in weight of 10.35 percent. Besides the destructive properties of C. *cephaionica,* it has some good aspects as well, as it acts as an alternate host for some egg parasitoids like *Trichogramma* species, which are used for biological control programmes of different destructive pests like sugarcane borers in many countries of the world (Choudhury and Duit, 1989; Meenakanit *et al.,* 1989; Chu-Yaui *et al.,* 1994; Mukhukrishnan *et al.,* 1996; Cadapan, 1988). The mass multiplication of the egg parasitoid, *Trichogramma chiionis* (Ishii) on the eggs of C. *cephaionica* as a factitious host was not only successful but also provided remarkable control of sugarcane borers in India (Nagarkati and Nagaraja, 1968). Considering this potential of C. *Cephaionica*, it is necessary to study the impact of different food stuff on the development of this insect.

Hence, the present research was undertaken to study the development of C. *cephaionica* on different food media with a view to find out a suitable food for this purpose.

Morphology

The eggs of *Corcyra cephalonica* are oval and measure 0.5 x 0.3 mm with white surface sculptured having short nipple-like process at one end. The larvae are generally creamish – white except for the head capsule and brown prothoracic tergite. There are well-developed prolegs on abdominal segments 3-6 and 10. A fully matured larva measures about 15 mm. The last-instar larva spins a closely woven, very tough, double-layered cocoon and develops into a dark-brown pupa. The anterior portion of the cocoon has a line of weakness through which the adult emerges. The adults are small with hind-wings pale-buff and the fore-wings mid-brown or greyish-brown with thin vague lines of darker brown colour along the wing veins. The males are smaller than females and sexual activity usually begins shortly after adult emergence **(Figure 1).** Pre-oviposition period is of about 2 days and egg-laying mainly occurs during the night. Although oviposition may continue throughout life, but the greatest numbers are laid on the second and third days after emergence,. Eggs take about 2-3 days to hatch. Optimum conditions for larval development of *C. cephalonica* are 30 – 32^{o}C and 70 per cent RH. The period from egg hatch to adult emergence is only 26-27 days. There is considerable variation in the number of larval instars; however, males generally have 7 and females have 8 instars. The last-instar larvae pupate within the food and adults emerge through the anterior end of the cocoon, where there is a line of weakness. The sex ratio is 1:1. The adult moth is nocturnal and is most active at night.

Figure. 1 Male and female of *Corcyra cephalonica*

Materials and Methods

The research work was carried out in Cytogenetics Lab, Centre of Research for Development, University of Kashmir during May to October 2017. The temperature, relative humidity and photoperiod in the laboratory were maintained at 28 ±1^{0}C, 60 ±5% and 12L: 12D, respectively during the study period. Food preference study: three different kinds of food i.e., (1) Wheat flour (2) Maize flour (3) mixture of wheat and maize flour (1: 1) were tested for development of C. *cephaionica.* Clean and healthy grains of wheat and maize were collected from local market. After sun drying, the grains were crushed separately in the 18 crushing mill, sieved through 0.50mrn mesh sieve, subjected to UV sterilization and finally preserved in separate airtight UV sterilized plastic boxes.

Similarly, another box was filled with the mixture of wheat and maize flour in 1:1 ratio each. The food materials were properly mixed with blender machine and used for experiment as when necessary.

Stock culture of rice meal moth

The eggs of rice meal moth were collected from the Biological control laboratory of the Entomology Division, SKAUST Kashmir and were kept in separate plastic bowls (29 cm dia. x 11 cm height) with three different test food medium/diet **(Figure. 2).** In each bowl, about 10,000 eggs were spread on 300g of respective food and 4 bowls were maintained for each food and tag labelling was maintained properly. The bowls were transferred into the insect rearing box having glass covers for better observation of the bowls and each box was divided carefully into three chambers by a very thick paper. Each chamber under glass cover was covered with thick and very transparent polythene sheet which was occasionally opened for better aeration and humidity purposes for the development of larval instars. The food was supplied as and when necessary in all the bowls. After 45 days, emergence took place and moths were collected in test tubes (10ml) and were placed into previously marked glass jars (10cm x 8 cmx I8cm) **(Figure 3).** Ten pairs of adults were placed in each jar containing an iron net as an oviposition site for the moths.

Figure 2. Eggs of *Corcyra cephalonica*

Figure 3. Adults collected after rearing process

Development

Eggs of C. *cephalonica* were collected from different food materials of the stock culture and were placed in separate pertidish (9 cm dia.) for hatching. The neonates were carefully collected with the help of a soft camel hair brush and were transferred to previously marked petridishes containing test food materials.

Ten larvae were kept in each petridish and four petridishes were maintained for each kinds of food. Fresh foods were given to the larvae at every 24 hours interval and uneaten food along with faeces was removed. After third instar, the larvae were transferred to larger petridishes (11cm dia) to avoid crowding. Data was taken on the larval mortality, larval duration and final larval weight for all tested food media. When feeding stopped, the larvae were kept undisturbed until pupation. The pupae obtained from various food media were transferred to separate petridishes (9cm dia.) covered with muslin cloth and pre-pupal and pupal periods were recorded. The adults emerged from different test food media were allowed to mate separately (single pair) in glass jars (11.5 cm height x 6.4 cm dia). The inner walls of glass jar were covered with filter papers and the top with fine mesh cotton cloth. Ten pairs of adults were used for each food medium. Eggs laid by each female were collected and the number was recorded daily and placed in previously marked petridishes with respective food medium for hatching. The oviposition period was recorded for each food medium. Observations were made every day in order to determine the

preoviposition period, oviposition period, incubation period, number of eggs laid and hatching percentage and adult longevity of both male and female moths.

Results and Discussion

Pre-oviposition period

A very short 1-2 days (Average 1.2 days) pre-oviposition period was observed under laboratory condition **(Table 1).** The highest preoviposition period was found on the mixture of wheat & maize flour, and the lowest preoviposition period was found on the wheat flour. The findings of pre-oviposition period was more or less in agreement with that of Alam (1965) who reported that female moth began laying within a day or two after copulation, whereas Chakravorty & Das (1985) reported that the pre-oviposition period lasted 8-22 hrs (Average 15.14 hrs) for virgin females and 6-26 hrs (average 14.47 hrs) for mated females on wheat and maize. Pajni *et al.* (1980) recorded pre-oviposition period of only 2 hrs on wheat.

Oviposition period

The duration between first and end of egg laying was found highest (5.28 days) on wheat flour and lowest (3.27 days) on maize flour and mixture of wheat and maize flour (3.45), which was significantly different among the foods ($P<0.01$).

Table 1. Pre-oviposition, oviposition and incubation period (days) of C. *cephatonica* developed in different food media

Tested food medium	Pre-oviposition period (Mean± SD)	Oviposition period (Mean± SD)	Incubation period (Mean± SD)
Wheat flour	1.29± 0.450	5.28± 0.84	3.48± 0.54
Maize flour	1.52± 0.63	3.27± 0.76	4.69± 0.74
Mixture of wheat and maize flour	1.69± 0.62	3.45± 0.71	3.77± 0.46

Incubation period

The incubation period was higher (4.69 days) on maize flour and was lowest (3.48 days) on wheat flour. Incubation periods recorded on mixture of wheat & maize flour was some way between the two (3.77 days) **(Table 1).** Ray (1994) observed that the period was 7 'days on maize, whereas Mbata (1989) observed that the period was about 4 days on maize that gave an agreement with the present findings.

Fecundity

The number of eggs laid by a female was 192.75 (mean) on wheat flour, 230.67 on maize flour, and 202.89 on the mixture of wheat and maize flour, respectively **(Table 2)**

Table 2. Fecundity and hatching rate of *C. Cephalonica* moth developed from different food media

Tested food medium	No of eggs laid/ Female (Mean± SD)	No of eggs hatched (Mean± SD)	Hatching rate (%) (Mean± SD)
Wheat flour	192.75± 46.54	180.75± 77.79	86.87
Maize flour	230.67± 36.19	157.75± 28.29	61.5
Mixture of wheat and maize	202.89± 59.93	191.75± 47.94	82.94

Hatching rate

The mean hatching percentage of eggs were recorded as 86.87, 61.53, and 82.94 on wheat flour, maize flour, and mixture of wheat & maize flour, respectively **(Table 2).** There was no significant difference among the hatching rate in different foods.

Larval duration

Total larval duration varied significantly among different food medium **(Table 3)**. Longest (43.17 days) and shortest (29.90 days) larval duration were observed when maize flour and wheat flour were supplied as food respectively. In case of Mixture of Wheat and maize flour, larval duration was 34.76 days.

Larval survival rate

The highest survival percentage (71.50) was recorded on wheat flour that was identical with mixture of wheat & maize flour (56.50%). The lowest survival percentage (43.00) was recorded on maize flour **(Table 3).**

Table 3. Larval duration and percent survival of *C.cephalonica* on different food media

Tested food medium Studied	No. of Larvae	Total duration (Mean± SD)	Larval survival (%)
Wheat flour	10	29.90± 1.50	71.50
Maize flour	10	43.17± 1.82	43.00
Mixture of wheat and maize flour	10	34.76± 0.82	56.50

Pupal duration

Pupal duration of male pupae took comparatively longer period than that of the female ones on all tested foods (P<O.OI). The highest duration of male pupa (9.75 days) was observed on the mixture of wheat & maize flour and the lowest on wheat flour (9.28 days). Whereas, the highest duration of female pupae (10.23 days) was also observed on mixture of wheat & maize flour and the lowest on wheat flour (9.40 days) and those were significantly different from each other (P<0.0l). No significant difference observed when the larvae reared on maize flour (9.65 days) and mixture of wheat & maize flour (9.75 days) **(Table 4).**

Table 4. Male and female pupal survival rate of *C. Cephalonica* on different food media

Tested food medium	Pupal duration (days)		Pupal survival (%)
	Male (Mean±SD)	Female (Mean±SD)	
Wheat flour	9.28± 0.72	9.40± 0.60	76.34
Maize flour	9.65± 0.35	9.82± 0.18	49.58
Mixture of wheat and maize flour	9.75± 0.20	10.23± 0.47	56.58

Pupal survival rate

The survival percentage of pupae was recorded as 76.34, 49.58, and 56.58 in wheat flour, maize flour and mixture of wheat & maize flour respectively, which were significant at 1% level of probability **(Table 4).**

Adult longevity

The highest longevity of male (7.55 days) was observed on mixture of maize & wheat flour and that was lowest (6.79 days) on wheat flour. In case of wheat flour longevity was 6.87 days. The longevity of female moth was slightly lower than that of the male moth, that was 7.64 days on mixture of wheat & maize flour and 5.28 days on maize flour (P<0.0l) **(Table 5).**

Table 5. Longevity (days) of male and female moth of *C. Cephalonica* on different food media

Tested food medium	Male (Mean± SD)	Female (Mean± SD)
Wheat flour	6.79± 0.54	6.58± 0.58
Maize flour	6.87± 0.57	5.28± 0.50
Mixture of wheat and maize flour	7.55± 0.53	7.64± 0.67

Three different media were used to rear the rice grain moth. The highest number of eggs emerged from maize flour (average 230.67) followed by maize and wheat flour (average 202.89). Alam (1965) reported that a single female could lay eggs up to 200 on wheat, while Islam (1971) reported that the maximum number was 280 on stored wheat. Ray (1994) reported that the net reproductive rate of female was 181.95 on maize. These results seem to be near of the present findings. The hatching rate was 86.87 and 82.94% on wheat flour, and mixture of wheat & maize flour, respectively**.** Longest (43.17 hours) and shortest (29.90 days) larval duration were observed when maize flour and wheat flour were supplied as food, respectively. Alam (1965) observed that the larval duration was lasted from 23-25 days and that was extended up to 55 days on wheat, such differences of findings from the present study might be due to variation of foods. However, Ray (1994) observed that the period was 41 days on maize. The highest larval survival percentage (71.50) was, recorded on wheat flour that was identical with the mixture of wheat & maize flour (56.50%). The highest longevity (7.64 days) of female moth was observed when the larvae emerged from the mixture of wheat and maize flour and that was lowest (5.28 days) on maize flour. Chen- Suchiung *et al*., (1998) observed that the adult duration were 12.9 and 16.4 days for mated and unmated male respectively and those were 8.1 and 10.2 days for mated and unmated female respectively. Seshagiri (1954) reported that the longevity for adult male was 7.2 days and for adult female moth was 5.3 days and those were very close to the present findings. Considering all the parameters, it can be concluded and suggested that for the development of rice meal moth, wheat flour is the best suitable food media followed by mixture of wheat and maize flour and last of all maize flour. The present study also revealed that wheat flour could be used as best food for the development of C. *cephalonica* under laboratory condition.

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