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Biology of *Anthrenus coloratus* Reitter (Dermestidae : Coleoptera) on four different food stuffs of animal origin under laboratory conditions

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Abstract
Biology of the beetle *Anthrenus coloratus* was studied on four different food stuffs of animal origin includes feathers, fur, dried silkworm pupae and moths of Bombyx mori under laboratory conditions, room temperature 23.4 ºC - 32.2 ºC (27.13 ± 1.52) and humidity 67.8% -87.3% (78.94 ± 0.86) to know the dietary effect on the developmental process.
The incubation period was 12-16 days. There are 6-7 larval instars. The life-cycle on four different food stuffs is as follows.
On feathers, total larval period was 127-149 (136.70 ± 1.32) days, pupal period was 9-13 (10.63 ± 0.34) days and total period was 148-175 (160.74 ± 1.97) days.
On fur, total larval period was 135-161 (147.95 ± 2.18) days, pupal period was 11-15 (13.00 ± 0.34) days and total period was 159-192 (174.68 ± 2.33) days.
On dried silkworm pupae, total larval period was 118-134 (127.10 ± 1.28) days, pupal period was 8-11 (9.75 ± 0.29) days and total period was 140-159 (150.45 ± 1.27) days.
On dried silk moths, total larval period was 121-139 (130.70 ± 1.32) days, pupal period was 9-12 (10.45 ± 0.24) days and total period was 145-163 (154.65 ± 1.30) days.
Even though, the beetle *A. coloratus* is found to be a major pest of stuffed birds and mammal in the zoological museums of educational institutions, the total time taken to complete the life-cycle is less (140-159 days) on dried silkworm pupae followed by 145-163 days on dried silk moths, 145-175 days on feathers and 159-192 days on fur.

Keywords: biology, dermestid beetle, *Anthrenus coloratus*, feathers, fur, dried silkworm pupae, silk moths, *Bombyx mori*

Introduction
Dermestid beetles feed on a wide variety of food materials of both animal and vegetable origin (Hinton, 1945) [11]. The beetle *Anthrenus coloratus* was bred from caraway seed and uncured antelope head in Sudan (Hinton, 1945a) [12] and was considered as minor pest of insect collection in North America (Kingsolver, 1969) [13]. According to Halstead (1974-75) [10] it was found in th Meditterean region, Asia and South Africa where it was found associated with stored products. Ansari and Basalingappa (1986) [5] reported the infestation of stuffed birds and mammals in the zoological museums by the larvae of *Anthrenus coloratus*. Mohammed Arshad *et al*. (1986) recorded the beetle from the nests of house sparrow and pigeon in Pakistan. The beetle was recorded from the British Natural (Entomology) Museum building in London (Armes, 1988) [8]. According to Veer and Rao (1991) [18] the larvae found damaging stored woolen fabrics in India. The beetle is reported from North America and Mexico (Beal Jr, 1998) [9]. A new record of *A. coloratus* from Thar Desert, Sindh in Pakistan (Zuber Ahmed, 2013) [20]. *A. coloratus* considered as a new pest in Italian entomological collections (Nardi and Hava, 2019) [16].
Different species of dermestid beetles found associated with sericulture industry (Hinton, 1945a, Masanori *et al*. 1972, Krishnaswami *et al*. 1973, Ansari and Basalingappa 1985, 1987 and 1989, Veer and Rao, 1996, Akinkunmi and Odebiyi, 2001 and Pera and Gonzale, 2014) [12, 15, 14, 3, 6, 7, 19, 1, 17].
Ansari and Basalingappa (1985a) [4] studied the influence of temperature and percent humidity on the life-cycle of *A. coloratus* reared on the feathers of stuffed birds. Ali (1997) [2] studied on the development and heat tolerance of *A. coloratus* reared on a laboratory diet includes dried

baby milk plus wool textiles. The aim of present study was to know the biology of the beetle *A. coloratus* on four different food stuffs at room temperature 23.4 ºC - 32.2 ºC (27.13 ± 1.52) and humidity 67.8% -87.3% (78.94 ± 0.86) and to know the dietary effect on the developmental process.

Material and Methods

The larvae of different instars of *A. coloratus* were collected from the stuffed zoological museum specimens of different educational institutions and reared the on feathers in plastic containers under laboratory conditions. Freshly emerged imagines were collected from the laboratory rearing stock and were allowed to mate. The mated females were separated and kept them singly in the plastic containers (3" x 2") provided with feathers as substrate for egg-laying. After oviposition, the eggs laid during first two days were collected and used to study the entire life-cycle on four different food stuffs of animal origin such as feathers, fur, dried silkworm pupae and moths of Bombyx mori under laboratory conditions, room temperature 23.4 ºC - 32.2 ºC (27.13 ± 1.52) and humidity 67.8% -87.3% (78.94 ± 0.86).

Results and Discussion

At the last larval instar, the larval skin found split along the mid dorsal line and the split commenced from the epicranial suture and extended backwards up to the seventh abdominal segment. The newly formed pupae remained within the last larval skin, the exuviae. At the end of pupation, the imagines emerged and remained as quiescent stage in the last larval skin for 2-11 (6.1 ± 1.1) days. The pupal covering was found shriveled up and attached to the tip of the abdomen of imagines.

As reported earlier there were 6-7 larval instars (Ansari and Basalingappa, 1985) and 7-9 instars (Ali, 1997) [2]. In present study also recorded 6-7 larval instars.

The incubation period was 12-16 days. Total larval period, pupal period and total life-cycle period on four different food stuffs of animal origin (feathers, fur, dried silkworm pupae and dried silk moths) are detailed in table 1.

Table 1: Biology of *Anthrenus coloratus* on four food stuffs of animal origin

Food stuffs	Incubation period of egg (days)	Larval period (days)	Pupal period (days)	Total period (days)
Feathers	12-16 (13.55+0.32)	127-149 (136.70 ± 1.32)	9-13 (10.63 ± 0.34)	148-175 (160.74 ± 1.97)
Fur	12-16 (13.70 +0.31)	135-161 (147.95 ± 2.18)	11-15 (13.00 ± 0.34)	159-192 (174.68 ± 2.33)
Dried silkworm pupae	12-16 (13.60+0.31)	118-134 (127.10 ± 1.28)	11-15 (13.00 ± 0.34)	140-159 (150.45 ± 1.27)
Dried silk moths	12-16 (13.50+0.32)	121-139 (130.70 ± 1.32)	8-11 (9.75 ± 0.29)	145-163 (154.65 ± 1.30)

The life-cycle on four different food stuffs is as follows

On feathers, total larval period was 127-149 (136.70 ± 1.32) days, pupal period was 9-13 (10.63 ± 0.34) days and total period was 148-175 (160.74 ± 1.97) days.

On fur, total larval period was 135-161 (147.95 ± 2.18) days, pupal period was 11-15 (13.00 ± 0.34) days and total period was 159-192 (174.68 ± 2.33) days.

On dried silkworm pupae, total larval period was 118-134 (127.10 ± 1.28) days, pupal period was 8-11 (9.75 ± 0.29) days and total period was 140-159 (150.45 ± 1.27) days.

On dried silk moths, total larval period was 121-139 (130.70 ± 1.32) days, pupal period was 9-12 (10.45 ± 0.24) days and total period was 145-163 (154.65 ± 1.30) days.

Ansari and Basalingappa (1985a) [4] reported 6-7 larval instars, whereas Ali (1997) [2] recorded 7-9 instars. According to Ansari and Basalingappa (1985a) [4] at room temperature 23.4 ºC - 32.2 ºC (27.13 ± 1.52) and humidity 67.8% -87.3% (78.94 ± 0.86) , incubation period was 12-15 (13.26 ± 0.3) days, larval period was 125-142 (133.05) days, pupal period was 8-11 (9.33 ± 0.29) days and the total life-cycle was 145-168 (156.5) days; at constant temperature of 30 ºC and 65% RH incubation period was 11-14 (12.80 ± 0.26) days, larval period was 117-139 (128) days, pupal period was 8-10 (9.05 ± 0.19) days and the total life-cycle was 136-163 (149.5) days and at constant temperature of 35 ºC and 65% RH incubation period was 10-12 (11.26 ± 0.19) days, larval period was 108-127 (117.5) days, pupal period was 7-10 (8.11± 0.19) days and the total life-cycle was 125-149 (137) days. Ali (1997) [2] reported incubation period as 8.3 ± 0.1 days, larval period 101.7 ± 4.4 days and pupal period 5.4 ± 0.1 days.

There are significant variations in these comparative results, may be because of the effect of food materials fed to the larvae of *A. coloratus*. There is wide scope to study the physiological aspects of the larvae based on the chemical composition of different food stuffs which influences the developmental process.

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