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Studies on life cycles of forensically important flies, *Calliphora vicina* and *Musca domestica nebulo* at different temperatures

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ABSTRACT

Life tables for two forensically important flies viz. *Calliphora vicina* and *Musca domestica nebulo* were generated at varying temperatures. The findings would help the forensic entomologists in legal investigations.

Blowflies (Diptera : Calliphoridae), flesh flies (Diptera : Sarcophagidae) and house flies (Diptera : Muscidae) have medical, veterinary and medico legal importance. They usually are the first to colonize a carcass, often within minutes of exposure (Catts and Goff, 1992; Greenberg, 1991; Greenberg and Kunich, 2002), if allowed access to a body, the adults feed on body secretions, including blood, and gravid females rapidly lay their eggs on the corpse. Eggs hatch in few hours depending on the temperature and larvae begin to feed on the body tissues. Once fully grown, the post-feeding larvae usually migrate away from the body to pupariate or in the immediate vicinity of the body depending on the species (Greenberg, 1991). The police or forensic entomologists can collect these stages, and can use them in calculating the post-mortem interval (PM I) of a body. Different species of flies grow at different rates, and to calculate the PMI of a body developmental data at different temperatures of forensically important species is required. According to Greenberg and Kunich (2000), "a considerable variation appears in the development rates of geographically different populations of forensically important fly species. Therefore, for calculation of PMI of a body data of a particular geographical area is required". During the present study, life tables of two such important flies *Calliphora vicina* and *Musca domestica nebulo* at different temperatures were studied.

MATERIALS AND METHODS

Adults of *Calliphora vicina* and *Musca domestica nebulo* were collected from animal carcasses at Patiala (Punjab, India). Adults were allowed to feed, mate and oviposit in rearing chambers (2 x 2 x 2 inches). A piece of goat liver placed on moistened filter paper in a petri dish was provided in the rearing chambers, which served as the oviposition medium. Eggs were transferred into a 200 ml glass jar the bottom of which was filled up to 5 cm with moistened saw dust to prevent desiccation. Mutton was provided as food for the emerging larvae. The jars were covered with muslin cloth and kept in incubators at varying temperatures. The jars were frequently checked to record the emergence of different life stages and to work out duration of different immature stages of the insects.

RESULTS AND DISCUSSION

Life Cycle *of Calliphora vicina* Robineau-Desvoidy, 1830: The genus *Calliphora* is represented by 12 species from the Oriental region (James, 1977). Out of which 4 species are reported from India. The so called blue bottles are large (10-14 mm) slow flying, loud buzzing, and bristly flies. They are found in urban, sub-urban areas, favor shady situation and may enter houses during cooler seasons (this species was recorded only during winter and spring season in the state of Punjab: Bharti and Singh, 2003). It is an eusynanthropic species frequently showing endophilic tendencies and is a facultatjve myiasis causer (Erzincljoglu, 1985; Greenberg, 1973; Hall, 1948; Nuorteva,1977 and Smith,1986). Adults usually feed on decomposing fruits, decaying meat and faeces. Larvae are chiefly necrophagous, develop on decomposing meat..

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During present study, life cycle *of Calliphora vicina* was run at 20°C, 25°C and 30°C. It was observed that at 20°C, *Calliphora vicina* takes 453.5 hrs or 18.89 days to complete its life cycle (Table 2 and 3). At 25°C, total of 367.0 hrs or 15.29 days were required by *Calliphora vicina* to complete its cycle at 25°C but at 30° C larvae of this fly failed to pupariate and died. Since *Calliphora vicina* is present only in the cooler months of the year it could provide an important clue during investigations. If a body is found infested with maggots of this fly in midsummer place where it is unlikely to be active, the body has probably been moved from a cooler area.

Life Cycle of *Musca domestica nebula* Fabricius, 1784: This species is distributed all over Asia and is especially common in India and Srilanka. This common housefly is true synanthrope that has followed man around the world. The adult is of medium size (6-7 mm), mouse grey in color. It occurs commonly in houses where it settles on food, refuse, faeces or on man itself. The adult feeds on almost anything with a moist surface and is particularly attracted to human faeces, manure heaps, garbage, fresh or decomposing meat and sweet food stuffs. In natural conditions, eggs are laid mainly on animal excrement, decaying vegetable matter, garbage, decomposing food stuffs, meat and carcasses which provide the emerging larvae with suitable medium for growth and nourishment.

During present study, life cycle of *Musca domestica nebulo* was studied at 20°C, 25°C, and 28°C. The housefly has a complete metamorphosis with distinct egg, larvae, pupal and adult stages. Total egg to adult period at 20°C was measured to 408.0 hrs or 17 days, at 25°C, 304.8 hrs or 12.7 days and at 28°C, 233.0 hrs or 9.7 days respectively (Table 1 and 3).

It is evident from the table 1 and 2, that life history of both *Calliphora vicina* and *Musca domestica nebulo* are temperature dependent. During low temperature, maximum time is spent as post-feeding stage and pupal stage (69.1 % at 20°C compared to 67.5% at 25°C in case of *Calliphora vicina* and about 64.2% at 20°C compared to 60.9% at 28°C in case *of Musca domestica nebulo)* (Table 1 and 2). As temperature increases more time is spent as instars (Le. 26.2% at 25°C compared to 24.9% at 20°C for *Calliphora* and 29.9% at 20°C, compared to 31.3% at 28°C as high temperature is conducive for larval growth. It was noticed that higher temperatures (30°C or above) accelerate the development of feeding instars of *Calliphora vicina,* but post feeding larvae

Table 1. Life Cycle *of Musca domestica nebul* at varying temperatures.

Temp.	Egg (hrs)	First instar (hrs)	Second instar (hrs)	Third instar (hrs)	P.F. (hrs)	Pupa (hrs)	Adult (hrs)
20°C	24.0	22.0	46.0	54.0	94.0	168.0	408.0
			122 hrs (29.9%)		(64.2%)		
25°C	17.0	25.0	32.0	35.0	55.8	140.0	304.8
			92 hrs (30.2%)		(61.02%)		
28°C	18.0	25.0	26.0	22.0	40.0	102.0	233.0
			73 hrs (3 1.3%)		(60.9%)		

Table 2. Life Cycle of *Calliphora vicina* at varying temperatures.

Temp	Egg (hrs)	First instar (hrs)	Second instar (hrs)	Third instar (hrs)	P.F. (hrs)	Pupa (hrs)	Adult (hrs)
20°C	27.0	47.0	21.0	45.0	33.0	280.5	453.5
		113 hrs (24.9%)			(69.1%)		
25°C	23.0	34.0	22.0	40.0	32.0	216.0	367.0
		96 hrs (26.2%)			(67.5%)		

Table 3: Average minimum duration (in days) of immature stages at different temperatures.

Calliphora vicina	Egg	First instar	Second instar	Third instar	PF	Pupa	Adult
20°C	1.12	1.95	0.87	1.87	1.37	11.68	18.89
25°C	0.95	1.41	0.9	1.66	1.33	9.0	15.29
Musca domestica nebula							
20°C	1.0	0.91	1.91	2.25	3.91	7.00	17.00
25°C	0.70	1.04	1.33	1.45	1.91	5.88	12.7
28°C	0.75	1.04	1.08	0.91	1.66	4.25	9.7

fail to pupariate and subsequently die. On the other hand, *Musca* being a warm weather fly is not able to withstand low temperature conditions and maximum time is spent as post feeding and pupal stage, about 64.2% at 20°C compared to 60.9% at 28°C (Table 1). These flies are good forensic indicators and have been put to use in several cases (Greenberg, 1985; Smith, 1986; Catts and Goff, 1992)

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