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Forensically Important and Seasonal Changes in Temperatures of Developmental Stages in Life Cycle of Sarcophagidae Fly, *Sarcophaga Africa*

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ABSTRACT
Sarcophaga Africa is one of the hairy maggot flesh flies that feeds on meat carrion, and dead and decaying matter of animals to complete its life cycle which is useful for post-mortem interval (PMI). Determination in forensic investigations. The actual life cycle hours and days are calculated due to the morphological parameter of the life cycle of Sarcophaga Africa were studied in different seasons; The Life cycle in the rainy season was completed in 270 ± 1.25 hrs (11.25 ± 0.40 days), when the maximum temperature was 27.02°C and the minimum temperature was 26.4°C; in summer season when the maximum temperature was 36.6°C and the minimum temperature 33.2°C, the life cycle was completed in 220± 1.17 hrs (6.16. ± 0.10 days), while in cycle was completed in 310 ± 1.35hrs (12.91 ± 0.21 days) when the maximum and minimum winter season life cm temperatures were 27.4°C and 17.2°C respectively. The temperature plays an important role in determining the developmental stages of the life cycle of Sarcophaga Africa which should be considered during PMI determination. The external parameters of different stages differ from season to season. Larvae were healthy and bigger in the rainy season but in summer were short and small-sized. The size of larvae in the winter season was also smaller than the size in both summer and rainy seasons.

KEYWORDS: *Forensic Insect, PMI season, Lifecycle Duration; Temp Change.*

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INTRODUCTION

Forensic entomology deals with entomological evidence that is relevant in legal cases, particularly those related to corpses. Proper identification of evidence is crucial as a misidentification may lead to inaccurate and erroneous conclusions with potentially dramatic consequences. Identification is usually made based on morphological characters observed in adults and compiled in identification keys. However, Morphological characteristics are sometimes difficult to observe or do not provide good discrimination among related taxa (Smith, 1986, Gennard, 2007, Wells & Stevens, 2010). Flesh flies of the genera *Sarcophaga* (Diptera: Sarcophagidae) are of considerable medical and economic importance since they are known as Myias-producing agents in animals and humans; and they can be used to determine the post-mortem interval (Gomes et. al., 2003). The development stage of insect species helps

forensic specialists to determine the time since death. Recovered insects from human cadavers, mostly flesh flies and flesh flies' larvae, can provide information on the conditions experienced by a body following death to determine the time since death, considerations of the critical factors affecting the rate of decomposition are important. These factors include the location of the body, temperature, general climate, time of year, insect activity, animal activity in the area, and the amount of rainfall (Nafte, 2000). Temperature is the most important factor affecting developmental rate Temperature and access to the cadaver are two important factors affecting insect succession and temperatures generally reduce the developmental period of Diptera (Campobasso et al., 2001).

MATERIALS AND METHODS

Sarcophaga Africa larvae were collected from the dead dog at Sheri village of Ashti tehsil in Beed district (M.S)-India and reared in the laboratory in the rearing box by feeding daily on fresh liver of sheep and goat and water-sweetened with honey. Morphological identification was done in the laboratory using the identification keys (Sukontason et al., 2003). About 80 eggs were collected in indifferent seasons (rainy, summer, and winter) with the help of fine brush and 50 eggs each were reared at the laboratory condition and the duration of different developmental stages and their morphological parameters (length, width, and weight) were determined. The temperature and the humidity were recorded by the Hygro-thermometer clock OPTILAB Model THC-20.

OBSERVATION AND RESULTS

Sarcophaga Africa, one of the flesh flies known as hairy maggot fleshfly, adult has a face and cheeks with dense silvery hairs, anterior spiracle of the adult is open and proepisternal seta (stigmatic bristle) present, The larvae have tubercles hence called hairy maggot, these tubercles along the body segment are knobs encircling mostly half of lower surface, spines are round-knob turned spirally three times around the base of each tubercle; absence of hairy like structure at the base of tubercles in the caudal region; anterior spiracles always with 09 papillae and very rear 08 papillae. The life cycle duration of Oxysarcodexi terminals in the rainy season was completed in 270 ± 1.25 hrs (11.25 ± 0.40 days), (Table 1) when the maximum temperature was 27.02°C and the minimum temperature was 26.4°C, but in summer season when the maximum temperature was 36.6°C and the minimum temperature 33.02°C, the life cycle was completed in 220± 1.17 hrs (06.16.04 ± 0.10 days), (Table 2) while in winter season cycle was completed in 310 ± 1.35hrs (12.91 ± 0.21 days) when the maximum and minimum temperatures were 27.4°C and 17.2°C respectively (Table 3). Size of the different developmental stages varied from season to season; in the summer season, the size of different stages was smaller than same stage in rainy season and bigger than the same stage in winter season.

Table 1: Duration of different life cycle stages of *Sarcophaga Africa* in rainy Season

Hours	Developed stage	Length (mm)	Width (mm)	Weight (mg	Temperature (°C)			Humidity (%)		
					Max.	Min.	Average	Max.	Min.	Average
15	Eggs	1.2 ± 0.08	0.4 ± 0.07	0.29 ± 0.02	28.1	26.3	27.2	70	46	56.5
39	1st Instar	4.4 ± 0.11	2.1 ± 0.25	9.6 ± 0.9	28.1	26.3	27.2	70	40	55
72	2nd Instar	8.5 ± 0.15	3 ± 0.02	26.2 ± 0.05	28.2	26.2	27.2	75	41	58
104	3rd Instar	11.2 ± 0.26	3.5 ± 0.28	55.4 ± 0.32	27.6	26.4	27.00	75	41	58
150	Prepupae	10.6 ± 0.14	4.2 ± 0.9	46.4 ± 0.05	27.2	26.2	26.7	76	39.00	57.5
270	Pupae	8.2 ± 0.36	3.2 ± 0.219	39.5 ± 0.13	27.3	26.5	26.4	70	43.42	56.71
	Adult	8.3 ± 0.27	3.6 ± 0.11	32.3 ± 0.19	27.5	26.5	27.00	75	38	56.5

±) Indicate SD of five values

Table 2: Duration of different life cycle stages of *Sarcophaga Africa* in summer season

Hours	Developed stage	Length (mm)	Width (mm)	Weight (mg	Temperature (°C)			Humidity (%)		
					Max.	Min.	Average	Max.	Min.	Average
11	Eggs	1.00 ± 0.05	0.2 ± 0.04	0.25 ± 0.01	35.1	33.3	34.2	71	50	60.50
30	1st Instar	4.1± 0.09	1.1 ± 0.24	8.6 ± 0.9	35.1	33.3	34.2	71	48	59.50
62	2nd Instar	7.5 ± 0.13	2± 0.02	22.2 ± 0.04	35.2	33.2	34.2	76	47	61.50
84	3rd Instar	10.2 ± 0.24	2.5 ± 0.26	49.4 ± 0.29	36.6	34.4	35.50	76	49	62.50
130	Prepupae	9.6 ± 0.12	3.2 ± 0.5	41.4 ± 0.2	36.2	34.2	35.2	77	49.00	63.00
220	Pupae	7.2 ± 0.36	2.2 ± 0.27	32.5 ± 0.09	36.3	34.5	35.4	72	53.42	62.71
	Adult	7.3 ± 0.27	2.4 ± 0.10	27.3 ± 0.13	36.5	34.5	35.00	78	58	68

±) Indicate SD of five values

Table 3: Duration of different life cycle stages of *Sarcophaga Africa* in winter season

Hours	Developed stage	Length (mm)	Width (mm)	Weight (mg	Temperature (°C)			Humidity (%)		
					Max.	Min.	Average	Max.	Min.	Average
20	Eggs	1.43 ± 0.02	0.4 ± 0.05	0.22 ± 0.02	27.4	21.1	24.3	31	26	28.50
48	1st Instar	4.5 ± 0.12	1.4 ± 0.11	8.2 ± 0.15	23.6	20.1	22.4	31	30	30.50
80	2nd Instar	7.2 ± 0.21	2.8 ± 0.12	24.3 ± 0.27	23.2	21.2	22.8	29	27	28.00
120	3rd Instar	9.6 ± 0.07	3.5 ± 0.26	47.7 ± 0.20	21.6	19.2	21.1	26	25	25.50
170	Prepupae	8.4 ± 0.20	4.4 ± 0.21	47.2 ± 0.21	21.6	18.2	20.5	25	24	24.50
310	Pupae	8 ± 0.31	4. ± 0.14	42.4 ± 0.34	21.8	17.6	20.1	25	23	24.00
	Adult	8.1 ± 0.22	3.7 ± 0.24	45.1 ± 0.03	21.6	17.2	19.8	24	20	22.00

±) Indicate SD of five values

DISCUSSION

Sarcophaga Africa are a species of medical and economic importance (Sukontason et al. 2008) and play an important role in solving forensic cases (Smith, 1986;) This flesh fly is one of the first colonizers of the corpse. Higher temperatures generally prop up egg hatching and accelerate the maturation of larvae which can double their size in a few hours. If the Sarcophagidae larvae have reached maximum length at the peak of feeding, they tend to decline progressively and about 75% of the Sarcophagid pre-adult cycle may be spent in post-feeding and pupation. The morphological parameter of different stages differs from season to season. Larvae were healthy and bigger in the rainy season but in the summer season life cycle duration was short and the size of different stages was small in the winter season, the life cycle duration was longer than rainy season but the size in the winter season was also smaller than the size in rainy season. A study on the effect of temperature on the different developmental stages of *Sarcophaga Africa* and life cycle duration in rainy season and low constant temperature of 10 °C reported that in rainy season life cycle duration completed in 11.04 ± 0.08 days when the maximum and minimum temperatures were 29°C and 26°C respectively. But in low constant temperatures 10 °C life cycle was completed in 25.38 ± 0.16 days (Abagail and Zambare, 2015), they reported the impact of temperature on the morphological parameters in the rainy season and low constant temperature. Effect of fluctuation of temperature on development of Sarcophagid flies Protophormia terraenovae was reported at 4-28°C and 9-23°C to their mean constant temperature, 16°C and, found that generally development at the greater fluctuation was fast and at the constant temperature was slow. The effect of the summation rate is suspected to have caused this difference in development rate because fluctuations above the mean enhance the rate comparatively more than temperatures below the mean can lower the rate (Warren and Anderson, 2013). For forensic investigations, entomological evidence found in the criminal scene around the corpse is collected

and preserved according to medico-legal standard procedures. Also, microclimatic temperatures obtainable in the maggot's immediate environment at the criminal site are established and linked retrospectively with the air temperature records. Assuming an average constant temperature, as is the case with corpses found indoors, maggots or pupae recovered from the scene are stored at a constant temperature till they pupate or the first adults emerge. Then their age can be used for PMI determination (Grassberge and Reiter, 2002).

CONCLUSION

In this study the effect of temperature on the life cycle of *Sarcophaga Africa* in different season indicate that the life cycle duration in the rainy season was completed in 11.25 ± 0.40 days, but in the summer season was 6.16. ± 0.10 days, days while in winter season was completed in 12.91 ± 0.21 days. The high temperature accelerated the development in summer and delayed the development in the winter season by about 3 days. Larvae were healthy and bigger in the rainy season and small in the summer season, while in the winter season larvae were smaller than summer and rainy seasons. Temperature plays an important role in the period of life cycle stages and hence correct temperature changes should be considered for PMI determination after the life cycle stages of *Sarcophaga Africa* are collected from the corpse.

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