

THE BIOLOGY OF *PHLEBOTOMUS LANGERONI* (DIPTERA: PSYCHODIDAE) UNDER LABORATORY CONDITIONS¹

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SUMMARY. We have done a laboratory study on the biology of *Phlebotomus langeroni* which was first recorded in El Agamy area, Alexandria, Egypt, where visceral leishmaniasis occurs. The fecundity, longevity and productivity were investigated in relation to the type of blood meal (human, guinea pig and chicken). Fecundity was significantly higher when females were fed on human than on chicken and guinea pig blood, where the mean number of eggs laid per female was 62.6 ± 1.9 , 56.6 ± 6.9 and 47.5 ± 3.2 [respectively. Females fed on human lived longer than those fed on guinea pig or chicken (14.1 ± 0.2 , 10.7 ± 0.4 and 7.6 ± 0.3 days respectively). There was a marked prolongation in larval development in case of guinea pig fed female than the two other cases (27.8 ± 0.8 , 24.1 ± 0.5 and 24.0 ± 0.8 days respectively). The nature of blood meal of the mother do not affect the pupal duration. The productivity (the number of adults produced from eggs of individual females) decreased significantly from human (28.4 ± 2.3) to guinea pig (16.0 ± 2.3), and chicken (13.8 ± 4.1). The high productivity of females fed on human and the anthropophilic feeding tendency, may account for the efficiency of *P. langeroni* as a vector of human diseases.

Key-words: *Phlebotomus langeroni*. Biology under laboratory conditions.

Biologie de *Phlebotomus langeroni* Nitzulescu, 1930 (Diptera, Psychodidae), en élevage de laboratoire.

RÉSUMÉ. La biologie de *Phlebotomus langeroni* en élevage a été étudiée à El Agamy (Alexandrie) où sévit la leishmaniose viscérale. La fécondité des femelles, leur longévité et la productivité des différents stades, ont fait l'objet d'une analyse fine en fonction du type de sang ingéré (homme, cobaye et poulet). Les femelles gorgées sur l'homme ont révélé une fécondité notablement plus élevée ($P < 0,01$) qu'après leurs repas de sang sur poulet et cobaye ; les nombres moyens d'œufs déposés ont été respectivement de $62,6 \pm 1,9$, $56,6 \pm 6,9$ et $47,5 \pm 3,2$. Les femelles nourries sur l'homme ont montré une longévité plus grande que celles qui l'ont été sur cobaye et poulet (respectivement $14,1 \pm 0,2$, $10,7 \pm 0,4$ et $7,6 \pm 0,3$). Les femelles alimentées sur cobaye ont produit des larves dont la durée de développement a été nettement augmentée par rapport à celles qui l'ont été sur l'homme et le poulet (respectivement $27,8 \pm 0,8$, $24,1 \pm 0,5$ et $24,0 \pm 0,8$ jours). La nature du repas sanguin n'a pas affecté la durée de pupaison. Le taux de

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productivité (c'est-à-dire le nombre d'imagos produits individuellement par femelle) a décliné de façon significative ($P < 0,01$) de l'homme ($28,4 \pm 2,3$) au cobaye ($16,0 \pm 2,3$) et au poulet ($13,8 \pm 4,1$). Le fait que la productivité soit plus élevée pour les femelles de *P. langeroni* gorgées sur l'homme et leur tendance à l'anthropophilie doivent contribuer à favoriser la transmission de la leishmaniose.

Mots-clés : *Phlebotomus langeroni*. Biologie en conditions expérimentales.

Introduction

Phlebotomus langeroni Nitzulescu was recorded by El Sawaf *et al.* (1984) and the epidemiological significance of its finding in a suburb of Alexandria, Egypt where visceral leishmaniasis was documented (Tewfik *et al.*, 1983), is discussed.

The female of *P. langeroni* was described and illustrated for the first time by El Sawaf *et al.* (1985) since the female of this species has never been caught before. *P. langeroni* was successfully colonized and maintained in a closed colony for 3 years or 22 generations. The different larval instars were described in 1986 by Lane and El Sawaf.

In the present report, we present the results of a laboratory study on the fecundity, longevity and productivity of *P. langeroni* in relation to the type of blood meal taken up by the female.

Materials and methods

FIELD COLLECTIONS

The laboratory colony of *P. langeroni* originated from blood-fed females collected inside houses in El Agamy, Alexandria. Collections were made with tube aspirator from June to September 1983.

LABORATORY CULTURE

Field collected females were allowed to lay eggs individually in numbered earthenware pots lined with plaster of Paris. After oviposition, females were mounted in Puri's medium and identified. Eggs laid by those females identified as *P. langeroni* were used to establish the colony. Establishment and routine maintenance of the colony were similar to those described by Schmidt (1964) for *P. papatasi* except that *P. langeroni* requires higher humidity (90 % R. H.) for successful colonization.

Two-day-old laboratory-reared females were allowed to feed on human, guinea pig or chicken. Human blood was offered to the females by introducing the arm of a human volunteer in the feeding cage. None of the animals used was anesthe-

tized, but instead were wrapped to a wooden board on their back; and introduced into the feeding cages. Fully engorged females were transferred to pots with males (five females and five males). All feeding trials were conducted at an ambient temperature of 27-30° C and 90 % R. H. with equal tendencies of feeding in light and dark.

Observations, results and discussion

FEEDING ON HOSTS

P. langeroni fed more readily on human than the guinea pig or chicken. The feeding preferences and behaviour of this sandfly have not yet been studied in the field. Such studies would be valuable in elucidating the ecology of pathogens such as leishmania parasites.

FECUNDITY

The effect of type of blood meal on fecundity was investigated. The largest number of eggs laid was obtained when females were fed on human blood, while those fed on guinea pig yielded the smallest number of eggs (*table I*).

Reports on fecundity of sandflies are often questionable since the number of eggs laid is usually different from the maximum number matured (Chaniotis, 1967). However, the concentration of protein ingested is related to the number of oocytes produced; as pointed out by Ready (1969), the erythrocyte fraction is more important than the plasma for egg production.

TABLE I. — Fecundity, adult life span and productivity data (means \pm S. E. and range) of *P. langeroni* fed on different hosts.

Blood meal source	No. eggs/♀*	Pre-oviposition period* (days)	Adult life span* (longevity) in days)	Productivity* (offspring/♀)
Human	62.6 \pm 1.9 (37-71)	7.2 \pm 0.5 (3-11)	14.1 \pm 0.2 (5-25)	28.4 \pm 3.3 (10-47)
Guinea pig	47.5 \pm 32.1 (16-67)	6.5 \pm 0.4 (4-10)	10.7 \pm 0.4 (6-15)	16.0 \pm 2.3 (2-36)
Chicken	56.6 \pm 6.9 (24-81)	4.9 \pm 0.7 (3-9)	7.6 \pm 0.3 (7-13)	13.8 \pm 4.1 (4-39)

* Differences are statistically significant at the 1-5 % level according to the Student T-test.

LONGEVITY

Females fed on human blood lived significantly longer ($P < 0.01$) than those fed on guinea pig or chicken blood. The average longevity of blood-fed *P. langeroni* was calculated as mean prefeeding period of 2 days + mean preoviposition period (table I).

Flies that survived oviposition (3 out of 33) and refeed were those obtained from groups of flies initially taking human blood. A second feeders flies were also observed by Beach *et al.* (1983) for *P. martini*, where five females out of many, survived to refeed on human blood and laid a second batch of eggs.

EGGS

Lane and El Sawaf (1986) described the eggs of *P. langeroni*. Egg hatching is synchronus, *i. e.*, all eggs laid by a single female hatch within 24 hours. Incubation periods for eggs laid by females fed on human, guinea pig and chicken were 8.54 ± 0.3 , 9.0 ± 0.4 and 7.6 ± 0.4 days respectively (table II). We concluded that the quality of blood taken by the female did not affect the egg incubation period.

TABLE II. — Duration (days) of immature stages (mean \pm S. E. and range)* of *P. langeroni* fed on different hosts under laboratory conditions of 27-30° C and 90 % R. H.

Hosts	Egg	Larval instars	Pupa	Total (egg-adult)
Human	8.5 ± 0.3 (6-12)	24.1 ± 0.5 (19-28)	9.0 ± 0.2 (8-11)	41.8 ± 1.0 (37-48)
Guinea pig	9.0 ± 0.4 (7-12)	27.8 ± 0.8 (22-37)	10.3 ± 0.2 (8-14)	47.09 ± 0.8 (41-54)
Chicken	7.6 ± 0.4 (6-9)	24.0 ± 0.8 (20-25)	9.5 ± 0.3 (8-10)	41.12 ± 1.1 (37-45)

* Statistical differences at the 1-5 % level were tested according to the Student T-test.

LARVAE AND PUPAE

A marked prolongation was observed in the duration of larvae produced from females fed on guinea pig than in the two other cases (table II). In addition a lack of synchronization in the speed of larval development occurred. Endris *et al.* (1984), stated that the duration of larval development of *Lutzomyia anthophora* is depen-

dent on temperature, quality of diet and on other factors. Since the larvae of *P. langeroni* were fed on a mixture of cow blood and dried rabbit faeces and maintained under constant conditions, the delayed development of larvae might be an influence of the quality of blood ingested by the female. The slight prolongation observed in the pupal duration (*table II*) when the female was fed on guinea pig is not significant and suggests that the nature of blood meal of the female do not affect the pupal duration.

PRODUCTIVITY

The productivity, expressed as the number of adults produced from eggs of individual females is presented in *table I*. The productivity of females fed on different hosts decreased significantly in the order, human > guinea pig > chicken. The higher productivity and the anthropophilic feeding tendency, may account for the efficiency of *P. langeroni* as a vector of human leishmaniasis.

LITERATURE CITED

1. BEACH R., YOUNG D. G., MUTINGA M. G. : New Phlebotomine sandfly colonies: rearing *Phlebotomus martini*, *Sergentomyia schwetzi* and *Sergentomyia africana* (Diptera: Psychodidae). *J. Med. Entomol.*, 1983, 20, 579-584.
2. CHANIOTIS B. N. : The biology of California *Phlebotomus* (Diptera: Psychodidae) under laboratory conditions. *J. Med. Entomol.*, 1967, 4, 221-223.
3. EL SAWAF B. M., BEIER J. C., HUSSEIN S. M., KASSEM H. A., ABDEL SATTAR S. : *Phlebotomus langeroni*: a potential vector of Kala Azar in the Arab Republic of Egypt. *Trans. R. Soc. Trop. Med. Hyg.*, 1984, 78, 421.
4. EL SAWAF B. M., KASSEM H. A., EL SAID S. : Description of the hitherto unknown female of *Phlebotomus langeroni* (Diptera: Psychodidae). *J. Med. Entomol.*, 1985, 22, 312-314.
5. ENDRIS R. G., YOUNG D. G., BUTLER J. F. : The laboratory biology of the sandfly *Lutzomyia anthophora* (Diptera: Psychodidae). *J. Med. Entomol.*, 1984, 21, 656-664.
6. LANE R. P., EL SAWAF B. M. : The immature stages of *Phlebotomus langeroni* (Diptera: Psychodidae). *J. Med. Entomol.*, 1986, 23, 263-268.
7. READY P. D. : Factors affecting egg production of laboratory-bred *Lutzomyia longipalpis* (Diptera: Psychodidae). *J. Med. Entomol.*, 1979, 16, 413-423.
8. SCHMIDT M. L. : A laboratory culture of two *Phlebotomus* species, *P. papatasi* and *P. orientalis*. *Bull. Wlth. Org.*, 1964, 31, 577-578.
9. TEWFIK S., KASSEM S. A., AREF M. K., AWADALLAH H. N., ABADIR A. : A preliminary report on two cases of visceral leishmaniasis in Egypt. *Trans. R. Soc. Trop. Med. Hyg.*, 1983, 77, 334-335.