Life-cycle, longevity and fecundity of *Suidasia pontifica* (Acari: Saproglyphidae) in a tropical laboratory

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Abstract

In the present study on the life-cycle of *Suidasia pontifica*, freshly laid eggs were observed until the emergence of adults; the development periods between stages were recorded. The eggs took an average of 16.0 ± 3.6 days to develop to adults. For longevity determination, newly emerged adults were kept at 25°C and observed until they died. Longevities of the different sexes were similar (p= 0.13). Production of eggs by mated females were monitored until egg production stopped and the female died. All mated females laid eggs. The average fecundity was 19.7 ± 16.2 eggs and the mean number of eggs deposited per day was 2.7± 1.5. Mated females and males survived an average of 37.3 ± 15.5 and 40.3 ± 17.2 days respectively. The longevity of the mated females, and males was also similar (p= 0.67). However, longevity of mated males was found to be significantly (p< 0.05) shorter than unmated males.

Key Words: *Suidasia pontifica*; life-cycle; longevity; fecundity

Introduction

Suidasia pontifica is a mite that is cosmopolitan in distribution. The species is a common inhabitant of house dust (Sharp & Haramoto, 1970; Pearson & Cunnington, 1973; Thomas *et al.*, 1976; Furumizo & Thomas, 1977; Galvao & Guitton, 1986). Pearson & Cunnington (1973) reported that the species may be involved in house dust sensitivity. Besides this, mites of the genus *Suidasia* can also cause dermatitis, infection of the human intestines and pulmonary "acariasis" (Shamsinak *et al.*, 1987; Martinez & Hoffmann, 1976). The mite has also been found damaging rice bran, groundnuts, peanut, milk confectionary, milk powder and processed fish (Fox, 1950; DeSouza & Pereira, 1970; Franzolin *et al.*, 1994; Ho, 1996; GueyeNdiaye & Marchand, 1989). Accidental ingestion of these mites may lead to some serious health problems (Ho, 1996). Earlier house dust mite (HDM) surveys in Malaysia conducted more than 20 years ago indicated that *S. pontifica* was a common species found throughout the country (Ho & Nadchatram, 1985; Ho & Nadchatram, 1984). A recent survey of HDM also demonstrated the presence of *S. pontifica* with a much higher mean number of mites than previously reported (Mariana & Ho, 1996; Ho & Mariana, 1994). Besides *S. pontifica*, *Suidasia nesbitti* was the other important Saproglyphids found in Malaysia. The average mean density of *S. pontifica* was about doubled the latter species (Mariana, pers. comm.).

A clear understanding of the biology of the species in the local environment is necessary so that effective means of controlling the mite can be devised. General observations showed that the species have 5 distinct life stages: egg, larva, protonymph, tritonymph and adult. Very little is known about the biology of this genus. Biological studies with respect to pre-reproduction period, reproductive period, fecundity, development time and longevity are important for determination of reproductive potential in any species of HDMs. Longer pre-reproductive period may limit reproduction and population development in laboratory cultures (Hart & Fain, 1988). Features such as mortality of eggs and longevity may also influence population dynamics in laboratory cultures. In the present study on the life-cycle of *S. pontifica*, the population dynamics of the species under local laboratory conditions, were determined.

Materials and Methods

Mites

S. pontifica colonies kept in the Division of Acarology, Institute for Medical Research, Malaysia, since January 1997 were used. These colonies contained mixed generations and were maintained in an air-conditioned room with an average temperature of 25°C ± 2°C, and relative humidity of 75%.

Test container

The containers used for the study were clear glass vials of height 3.5 cm and diameter 2.0 cm. A sheet of cigarette paper was placed over the mouth of each vial. The paper was secured in place with a plastic snap cap which had a 1 cm diameter hole in the centre. Held in such a manner, the paper allowed ventilation of the vials and prevented the escape of the mites. Approximately 2 mg of food were introduced and evenly spread over the floor of the vial. All the vials were kept in a dessicator containing a saturated sodium chloride solution which

maintained the relative humidity inside the dessicator at 75%. The dessicator was kept at 25°C.

Life cycle duration
Two hundred and fifteen freshly oviposited eggs were placed individually in separate vials. The contents of the vials were observed once daily and the duration of development of various stages from egg to adult was recorded.

Longevity of adults
Forty one adults (12 females and 29 males) which had newly emerged from isolated pharate adults were kept individually in separate vials. The mites were observed once daily until they died. The number of days they lived was recorded.

Fecundity and longevity of reproductive females
Twelve pairs of freshly emerged adult males and females were used for the study. They were paired immediately after emergence from pharate stages. Each pair was placed in a separate vial. Counts of eggs laid were made once daily. The eggs deposited each day were then removed from the vial. Each female was monitored until it died. The longevity of males was also monitored. Observation on fecundity of the females was continued even if the males died before the females; however the dead males were not replaced.

The period between the deposition of the first and last eggs was defined as the reproductive period. Fecundity was the total number of eggs laid per female and rate of reproduction was calculated as the number of eggs laid per day of a female's reproductive period. Pre-reproductive period is the time beginning from the newly emerged females been introduced to the males, to deposition of the first egg.

Statistical analysis
Student's t test with a 95% confidence level was used for the comparison of longevities.

Results

Life cycle duration
The duration of development of each stage from egg to adult is shown in Table 1. Eggs took an average of 16.0 ± 3.6 days to develop to adults. Of the 215 eggs prepared, only 95 (44%) successfully became adults. Fifty-two eggs (24%) did not hatch. Mortality was present in all stages. The highest mortality was in the egg stage. The percentage mortality observed in the larval , protonymph and tritonymph stage was 15%, 7% and 8% respectively. Mortality was also observed in the pharate stages. Among the pharate stages, pharate adult stage showed the highest mortality (12%). Two percent of mortality was observed in pharate protonymph and 6% in pharate tritonymph.
Egg development time was longer than the other stages. Duration of the egg stage was approximately 26% of the total development time. This is followed by the larval stage (19%). Protonymphal stage and tritonymphal stage have equal percentage of development time (17%).

Longevity of adults
The total mean longevity for adults (males and females) were 49.5 ± 28.1 days. The mean longevities of individual females and males were 53.0 ± 36.0 and 67.9 ±

Table 1. Developmental period of life cycle stages of *Suidasia pontifica* at 25°C and 75%RH

Stages	No. examined	Duration (days)	Mean±SD (days)	Mortality rate (%)
Egg	215	1-10	4.1 ± 1.8	24.2
Larva	163	1-10	3.1 ± 1.6	15.3
Pharate Protonymph	138	1-5	1.3 ± 0.6	2.2
Protonymph	135	1-6	2.7 ± 1.6	7.4
Pharate Tritonymph	125	1-4	1.2 ± 0.5	5.6
Tritonymph	118	1-8	2.7 ± 1.5	8.5
Pharate Adult	108	1-6	1.3 ± 0.8	12.0
Total		9-25	16.0 ± 3.6	

Table 2. Longevity of adults of *Suidasia pontifica* at 25°C and 75%RH

Stages	No. examined	Duration (days)	Mean ± SD (days)
Adult	95	1-116	37.5 ± 31.4
Female	12	2-116	44.6 ± 37.9
Male	29	6-100	63.7 ± 25.3
Mated female	12	16-63	37.3 ± 15.5
Mated male	12	16-68	40.3 ± 17.2

Table 3. Student's t-test analysis of the longevity of sexes at 95% confidence interval

Comparing groups	Probability (P)	Significance
Females and males	0.13	Not significant
Females and mated females	0.2	Not significant
Males and mated males	0.01	Significant
Mated females and mated males	0.67	Nor significant

Table 4. Reproductive statistics for *Suidasia pontifica* (n = 12 pairs)

	Duration (days)	Mean ± SD (days)
Pre-reproductive period	2-8	3.6 ± 1.9
Reproductive period	1-51	19.9 ± 15.6
Fecundity	5-60	19.7 ± 16.2
Rate of reproduction	1-5	1.4 ± 1.1
No. egg-laying days	1-12	6.3 ± 3.1
No. egg/egg laying day	1-5	2.7 ± 1.5

20.6 days respectively (Table 2). There was no significant difference between the longevities of the 2 sexes (p= 0.13) (Table 3).

Mated females and males survived an average of 37.3 ± 15.5 and 40.3 ± 17.2 days respectively. The difference in longevity of the mated females and males was not significant (p= 0.67). Longevity of the mated males was found to be significantly shorter than unmated males (p<0.05). One (8%) of the mated females died on the same day as the males. It was observed that 8 of the mated females (66.7%) died before the males and 3 females (25%) died after the males.

Fecundity

Reproductive data for *S. pontifica* are shown in Table 4. All of the mated females lay eggs. The pre-reproductive period had a mean of 3.6 ± 1.9 days, and the average reproductive period was 19.9 ± 15.6 days. The average fecundity was 19.7 ± 16.2 eggs. The number of egg-laying days ranged from 1 to 12 days with a mean of 6.3 ± 3.1 days. The mean number of eggs deposited per day was 2.7± 1.5.

Discussion

The average duration taken to complete the life-cycle from egg to adult in this study is within the range observed by other workers studying *Suidasia nesbitti* (Saha & Modak 1992; Chmielewski, 1991). At 20-22°C and 78% relative humidity (RH), the development period from egg to adult of *S. nesbitti* ranged from 13-20 days (Saha & Modak, 1992). At a higher temperature of 25°C and a higher RH of 85%, the same species completed irs life-cycle in 10-21 days (Chmielewski, 1991).

Under the same laboratory conditions, development period of all stages in the life-cycle of *S. pontifica* was found to be much shorter than another 2 important

Table 5. Development period of life cycle stages of *Suidasia pontifica* (SP) compared to *Blomia tropicalis* (BT)[1] and *Dermatophagoides pteronyssinus* (DP)[2] at 25°C and 75%RH

Stages	Duration (days)			Mean (days)		
	SP	BT	DP	SP	BT	DP
Egg	1-10	5-8	4-9	4.1	5.7	5.7
Larva	1-10	2-13	4-18	3.1	4.2	8.8
Pharate Proronymph	1-5	1-5	1-4	1.3	1.7	2
Proronymph	1-6	1-7	1-10	2.7	3.1	6
Pharare Tritonymph	1-4	1-2	1-4	1.2	1.2	2.1
Tritonymph	1-8	1-9	4-11	2.7	3.8	7.4
Pharate Adult	1-6	1-3	2-3	1.3	1.8	2
Total	9-25	17-38	24-43	16	22.9	33

1. Mariana *et al.* (1996); 2. Ho & Nadchatram (1984)

species of HDM in Malaysia, *Blomia tropicalis* (Mariana *et al.*, 1996) and *Dermatophagoides pteronyssirius* (Ho & Nadchatram, 1984) as shown in Table 5.

The capacity of a population to increase in numbers is affected by the ability of the individuals in the population to survive to adulthood and to reproduce. In this study, only 44% of eggs developed into adults. Mortality was present in all stages with the egg stage presenting the highest morrality. A higher mortality in the egg (25% and 46%) had also been reported for *S. nesbitti* (Saha & Modak, 1992; Chmielewski, 1991). The high mortality in the egg stage might be due to the longer development times involved when compared to the other stages. Minor fluctuations in temperature and humidity to the HDM populations in the tropics during development time may affect their survival (Colloff, 1991).

The unmated adult can live for 11 to 116 days and the mated ones 16 to 68 days. Females developed faster than males. Longevity of the mated males was significantly shorter than the unmated males. The reason for this phenomenon is not clear. However, one of the reasons might possibly be the early death of the males after copulation. Females of *S. pontifica* lived much shorter than the males; the females had a longevity of 53 days. In contrast, females of *S. nesbitti* was reported to have a longer longevity of 67 days (Chmielewski, 1991).

Although using the same temperature of 25°C, the reproductive period, fecundity and rate of reproduction for *S. pontifica* was found to be much shorter when compared to those reported by Chmielewski (1991). Differences in the type of food and RH are possible contributory factors. Chmielewski (1991) used yeast and a 85% RH to culture the mites.

Eggs of *S. pontifica* were first oviposited 2-8 days after pairing of the adults. A female laid 1 to 10 eggs within a 24 hour period. This rate is considered to be relatively high when compared to *D. farinae* which can only lay 1 to 5 eggs in the same duration (Furumizo, 1973). True fecundity of the females was observed only in 9 individuals where they died before or on the same day as the males. For the other 3 pairs with which the males died before the females, the dead males were not replaced. These data are misleading as they will not reflect true fecundity of the females. This is because a single female can copulate up to 4 times in her lifetime (Furumizo, 1973). Moreover, Cunnington (1985) suggested that the females needed to be mated repeatedly to attain maximum production.

Five mated females were observed to have laid their eggs in 2 to 3 batches. After the first period of laying eggs, they stopped for a period of 5 to 20 days before continuing to lay eggs for the next batch. These observations had confirmed that *S. pontifica* could mate a second and third time and then resume egg production. This is possible because both the male and female of HDM had been observed to mate more than once (Oshima & Sugita, 1966; Spieksma, 1967 a;

Larson *et al*., 1968; Furumizo, 1973; Harwood & James, 1979; Nutting, 1984). The first oviposition period lasts abour 12 days with 1 to 10 eggs laid per day. A second and third oviposition period occurred but fewer eggs (1-7 eggs) are laid. This second and third oviposition were also observed by Spieksma (1967) and Oshima & Sugita (1966).

The reproductive period of *S. pontifica* lasted 4 to 51 days. Because of this shorter reproductive period, the number of eggs produced by *S. pontifica* in the study was less compared to *S. nesbitti* which was reported to lay 64-348 eggs throughout the reproductive petiod. At the same temperature and relative humidity used in this study, Larson *et al* (1969) observed that mating of female *D. farinae* in the first half of her life will only result in egg laying. This agreed with our findings where the reproductive period of *S. pontifica* was observed to be almost half of her life.

The data obtained in this study should be considered as baseline data under the specified laboratory conditions. The effect of change in temperature, RH and food type on population dynamics of *S. pontifica* should be investigated further for optimizing culture conditions. Egg production must be carefully studied because many factors bearing on it are still unevaluated. Other factors such as type of food given to the mated females should be investigated further for maximizing egg production.

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References

Chmielewski W (1991). Biological observations of the allergenic mite *Suidasia nesbitti* (Acarida, Saproglyphidae). *Wiadomosci Parazytologiczne* 37(1), 133-136.

Colloff MJ (1991). Practical and theoretical aspects of the ecology of house dust mites (Acari: Pyroglyphidae) in relation to the study of mite-mediated allergy. *Review of Medical and Veterinary Entomology* 11/12, 611-630.

Cunnington AM (1985). Factors affecting oviposition and fecundity in the grain mite *Acarus siro* L. (Acarina: Acaridae), especially temperature and relative humidity. *Experimental and Applied Acarology* 1, 327-344.

DeSouza ME & Pereira DG (1970). The presence of mites in feed of birds. *Resumos da II Reuniao Anual, Recife, Pernambuco, Brazil. Recife, Sociedade Brasileira de Entomologia*, 26 pp.

Fox I (1950). A new pyroglyphid mite from Puerto Rico. *Proceeding of the Biological Society of Washington* 63, 205-208.

Franzolin MR, Baggio D, Correia M, Rodriguez R (1994). Presence of mites in peanut and milk confectionery sold by street vendors in Sao Paulo city. *Revista da Instituto Adolfo Lutz* 54, 11-15.

Furumizo RT & Thomas V (1977). Mites of house dust. *Southeast Asian Journal of Tropical Medicine and Public Health* 8, 411-412.

Furumizo RT (1973). The biology and ecology of the house dust mite *Dermatophagoides farinae* Hughes, 1961 (Acarina: Pyroglyphidae). Ph.D. dissertation. University of California, Riverside, 143 p.

Galvao AB & Guitton (1986). Mites in house dust from the capitals of Brazilian States and the Island of Fernando de Noronha. *Memorias do Instituto Oswaldo Cruz* 81, 417-430.

Gueye-Ndiaye A & Marchand B (1989). *Lardoglyphus konoi* and *Suidasia pontifica* damaging dried, braised sardinelles in Senegal. A scanning electron microscope study. *Lardoglyphus konoi* et *Suidasia pontifica* depredateurs des sardinelles brasees-sechees au Senegal. Etude en microscopie electronique a balayage. *Acarologia* 30(2), 131-137.

Hart BJ & Fain A (1988). Morphological and biological studies of medically important house dust mites. *Acarologia* 29, 285-295.

Harwood RF & James MT (1979). *Entomology in human and animal health*. 7th. ed. Macmillan, New York, 548 pp.

Ho TM (1996). First report of *Suidasia pontifica* (Acari: Acaridae) in milk powder. *Southeast Asian Journal of Tropical Medicine and Public Health* 27(4), 1802-1803.

Ho TM & Mariana A (1994). The efficacy of a vacuum cleaner for the control of dust mites in mattresses. *Tropical Biomedicine* 11, 135-138.

Ho TM & Nadchatram M (1985). Distribution of *Dermatophagoides pteronyssinus* (Astigmata: Pyroglyphidae) in Cameron Highlands, Malaysia. *Tropical Biomedicine* 2, 54-58.

Ho TM & Nadchatram M (1984). Distribution of house dust mites in a new settlement scheme in Jengka, Pahang, Malaysia. *Tropical Biomedicine* 1, 49-53.

Ho TM & Nadchatram M (1984). Life-cycle and longevity of *Dermatophagoides pterynossinus* (Trouessart) (Acarina: Astigmata: Pyroglyphidae) in a tropical laboratory. *Tropical Biomedicine* 1, 159-162.

Larson DG, Mitchell WF & Wharton GW (1969). Preliminary studies on *Dermatophagoides farinae* Hughes, 1961 (Acari) and house dust allergy. *Journal of Medical Entomology* 6, 295-299.

Larson DG, Mitchell WF & Wharton GW (1968). A second species of house dust mite, *Dermatophagoides farinae* Hughes involved in house dust allergies. *Proceeding of the National Centre British Entomology Society of America* 23, 74.

Mariana A & Ho TM (1996). Distribution of *Blomia tropicalis* in Malaysia. *Tropical Biomedicine* 13,85-88.

Mariana A, Ho TM & Heah SK (1996). Life-cycle, longevity and fecundity of *Blomia tropicalis* (Acari: Glycyphagidae) in a tropical laboratory. *Southeast Asian Journal of Tropical Medicine and Public Health* 27(2): 392-395.

Martinez MR & Hoffmann A (1976). Three cases of human intestinal infestation by mites in Southern Veracruz. *Revista Investigacim de Salud Publica* 36, 187-201.

Nutting WB ed. (1984). *Mammalian diseases and arachnids*. Vol I. Pathogen biology and clinical management. 277 pp. Vol II. Medico-veterinary laboratory and wildlife diseases and control. 280 pp. CRC, Boca Raton.

Oshima S & Sugita K (1966). Life history of *Dermatophagoides farinae* Hughes, 1961 (Acarina: Epidermoptidae). *Bulletin of Yokohama Municipal Institute of Public Health* 4, 66-69.

Pearson RSB & Cunnington AM (1973). The importance of mites in house dust sensitivity in Barbadian asthmatics. *Clinical Allergy* 3, 299-06.

Saha GK & Modak A (1992). Laboratory observations on the life-cycle of *Suidasia nesbitti* (Acari: Acaridae). *Bengal National Histological Society* 11, 63-66.

Samsinak K, Peicoch M & Vobrazkova E (1987). Mites of the genus *Suidasia* as the causative agent of dermatitis. *Anzeiger fur Schadlingskunde Pflanzenschutz, Unweltschutz* 60, 113-115.

Sharp JL & Haramoto FH (1970). *Dermatophagoides pteronyssinus* (Trouessart) and other Acarina in house dust in Hawaii. *Proceeding*

of the Hawaiian Entomology Society 20,583-589.

Spieksma FThM (1967). The house dust mite *Dermatophagoides pteronyssinus* (Trouessart, 1897), producer of the house dust allergen (Acari: Psoroptidae). Ph. D. Thesis, University of Leiden, The Netherlands, 65p.

Spieksma FThM (1967 a). The house dust mite *Dermatophagoides pteronyssinus* (Trouessart, 1897), producer of the house dust allergen (Acari: Psoroptidae). U Leiden x + 65p.

Thomas V, Tan BH & Yap PL (1976). Mass rearing of mites collected from house dust samples. *Medical Journal of Malaysia* 30, 331-333.

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