Observations on the biology of *Hormosianoetus mahunkai* Eraky and Shoker, 1993 (Acari: Histiostomatidae)

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ABSTRACT

This study was conducted to throw lights on the effect of food types on the biological aspects of *Hormosianoetus mahunkai* Eraky and Shoker, collected from a culture of fungus, *Fusarium oxysporum*. Generation period as well as female life span, and fecundity were recorded when reared on dry yeast granules, wheat germ and *F. oxysporum* separately at 27+2 °C and 85+5 % R.H.. The longest female Life cycle of was when fed on *F. oxysporum* (4.450 days) while the shortest was recorded for males when fed on dry yeast granules (2.760 days). Females lived shorter than males and its fecundity recorded the highest number of deposited eggs when fed on dry yeast granules (181.000 eggs with daily rate 12.800 egg/day) followed by Wheat germ and *F. oxysporum* (158.500 and 144.500 eggs), respectively.

Key words: Acari, Histiostomatidae, *Hormosianoetus mahunkai*, biology.

INTRODUCTION

Histiostomatidae (= Anoetidae, Oudemans, 1904), is one of the Astigmata largest families with about 500 species of 58 genera (Kurosa&Tagami 2006; OConnor 2009), and commonly inhabits the wet microhabitats. Some acaroid and anoetoid (Acaroidea, Anoetoidea) mites under unfavorable life conditions changed to hypopus specimens to adapt for the spreading and survival (Behura, 1957; Eraky, 1987; Chmielewski, 1971, 1977; Hughes, 1976; Kuo and Nesbitt, 1970; Wallace, 1960). The ecological and biological studies of this mites group are rare world, is likely due to the difficulty understanding (Bongers, *et. al* 1985).

The phortetic mites of the family Histiostomatidae have been frequently collected from various species of insects (prevailing Diptera and Coleoptera) (Scheucher 1957; Hughes & Jackson 1958; Mahunka 1972; Samšiňak 1984, 1989; Mašan & Krištofik 1992), and soil or litter samples, decaying vegetables, mushrooms, fruits and animal faces (Kazumi and Yasumasa, 2005), furthermore, found associated with stored grain, seeds of different crops . *Histiostoma halicticola* species was found with high population on the ground-nesting phoretic on the solitary bee, *Halictus sexcinctus* (Fain & Erteld, 1998). On the other hand, the histiostomatid mites were observed feeding on the fungi growing on grain dust and decaying organic debris confirm an adequate food supply for mites in empty granaries (Muhammad, *et al.* 2000). In Egypt Knowledge concerning about the Acaridides fauna is few as compared to other groups of mites. Moreover, several taxa were found to be new and several morphological characteristics were described. Many species and few genera belonging to the Acaridida mites were recorded in Upper Egypt by Eraky (1992; 1994 a, b; 1997; 1998; 1999 a, b, c; 2000 a, b); Eraky and Shoker (1993 a, b; 1994); Eraky and Osman (2008 a, b, c); Fakeer *et al*. (2014) and Eraky *et al*. (2017). Although, histiostomatid mites have been identified as pests of many hosts studies began by histiostomatid mite fauna of cattle dung with the view that some of these mites may have potential importance either as actual dung decomposers or as predators or parasites of dung inhabiting fly larvae. They noticed that some species in the family Histiostomatidae are known to feed on fly eggs and larvae, for example *Histiostoma laboratorium* Hughes, 1950, which is associated with *Drosophila* cultures. Information about life cycle of histiostomatid mite species was described as possible by Hughes & Jackson (1958) and Scheucher (1957). Since that time, the studies have concentrated on descriptions of new taxa.

The biological study on this family is rare. So, the present work aimd to study the effect of different food types (dry yeast granules, wheat germ and *F. oxysporum*) on the biological aspects of the mite, *H. mahunkai* which erected by Eraky and Shoker, (1993) from uprooted banana suckers at 27+2º C. and 85+5 % R.H.

MATERIALS AND METHODS

Stock colonies of *H. mahunkai*

Individuals of *H. mahunkai* were collected from *F. oxysporum* cultured in plant pathology department, Shandaweel Agricultural Research Station, Agricultural Research Center (ARC), Sohag, Egypt, and then cultured in the laboratory. Two types of plastic cells containing a floor of plaster of pairs (gypsum: clay: charcoal) with percent of (6:3:1), respectively filled on the bottom of cages to depth of 0.5 cm. Its bottom was scratched by using a needle to make convexo-concaved areas used as shelters and was suitable sites for histiostomatid mites rearing and laying eggs (Zaher *et al*. 1981) and (Hassan *et al*., 2014). The big rearing cells 2.5 cm diameter and 2 cm deep were used for laboratory culture. The small ones

were 1 cm diameter and 0.8 cm deep was used in the biological experiments. A glass cover was used for each cell to prevent mites escape.

Histiostomatid mites cultures were kept in big rearing cells representing three major groups according to tested food (dry yeast granules, wheat germ and *F. oxysporum*) under laboratory conditions (27+2 ºC and 85+5 % R.H.). Ten adults (female and male) were placed in rearing chamber and provided with experimental food mentioned above, with adding few drops of water by using minuten probe as source of humidity and then placed in an incubator for investigated every 12 h, each rearing chamber was supplied with food types and water at needed

Mite larvae were reared individually on each feeding source in big cells and observed every 12 h. until maturation. As soon as females emerged, males were introduced for mating. Eggs were collected during 12 hours. Eggs were solitary placed into small rearing cells with the aid of camel hair brush and incubated at the same conditions mentioned above. Forty fresh eggs of the same age (one-day old) were used per each rearing material and observed every 6 h. until hatching and mites become mature. Eggs laid by each female mite were counted daily until female died. At each rearing diets, the incubation period, immature stages, life cycle, longevity of both males and females, and fecundity (total number of eggs laid per female) were calculated. Experiments on the fecundity and longevity of the *H. mahunkai* were undertaken. Identification of specie was carried out by Prof. Dr. Sayed Eraky, Department of Plant Protection, Faculty of Agriculture, Assiut University, Assiut, Egypt.

Statistical analysis:

The data was subjected to analysis of variance (ANOVA) and the means were separated using Least Significant Difference (LSD).

RESULTS AND DISCUSSION

The biological aspects of *H. mahunkai* have been affected by food types under laboratory conditions (27±2°c and 85 ±5 RH %). The developmental stages were egg, larva, protonymph, heteromorphic deutonymph (hypopi), tritonymph and adult. In similar data in the same sub-ordere astigmata Houck and OConnor (1991) use the term heteromorphic deutonymph instead of hypopus to refer to this specialized, facultative stage. The two nymphal nymphal stages are easily separated, since the protonymphs have two, while the tritonymph have four genital suckers, The results demonstrated that the first three stages (larval, protonymphal and tritonymph) of this mites were active and feed with a quiescent period prior to molting for each stage (Eraky, 1987). Members of the *H. mahunkai* mite showd a considerable variation in their feeding habits when fed on dry yeast granules; wheat germ and *F. oxysporum* fungus. There are interesting biological feature of *H. mahunkai* is an a parity phenomenon, i.e. the development of progeny (various stages- eggs, larvae, nymphs, including hypopi, except imagines) inside the body of dead females (as opposed to normal development outside the female body i.e. viviparity); in this case the hatching larvae and other developing juvenile specimens use the internal mother's tissues as food. This result was described previously on species in the same sub-order Astigmata by (Lipa and Chmielewski, 1966; Chmielewski and Lipa, 1967; Chmielewski, 2003). A parity has been reported long time ago in other species representatives of other mite groups, e.g. in Oribatida (Vitzthum, 1943).

Incubation period and hatching.

Females deposited their eggs singly or in scattered pattern and covered it by its food, these eggs are whitish then become creamy before hatching.

Egg incubation period was noticed when the females fed on dry yeast granules, wheat germ and *F. oxysporum* lasted 1.000, 1.175 and 1.275 days, respectively, while that of males lasted 1.000, 1.125 and 1.210 days. The statistical analysis of obtained data showed that L.S.D. at 0.05 = (0.1902 and 0.1758) for female and male, respectively. Results similar Eraky, (1987) conducted the Incubation period of *Caloglyphus berlesei* were 1.5 days at 28°C when fed on yeasted *Drosophilla*.

Immature stages.

Both of *H. mahunkai* male and female pass through three active developmental stages (larva, protonymph, tritonymph) before reaching adult. Each active stage is followed by quiescent). Significant differences occurred between the individuals when fed on dry yeast granules; wheat germ and *F. oxysporum* average 1.973, 2.316 and 3.175 days, respectively for female. Table (1) male followed similar results

Life cycle:

Concerning life cycle duration (egg, larva, protonymph, and tritonymph), is completed with the appearance of adults. Data in table (1) showed that differed significantly on different diets on the life cycle of *H. mahunkai* females and males. It was longer when females and males reared on *F. oxysporum* followed by wheat germ and dry yeast granules (4.450, 3.491 and 2.973) days, and (3.990, 3.268 and 2.760) days with L.S.D. at 0.05 level = 0.3439 and 0.5146, respectively.

Generally, male immatures had shorter life cycle than these of female. Similar results were obtained by

Table (1): Duration in days of *H. mahunkai* immature stages, when fed on different diets at 27± 2 ºC and 85 ± 5 % R.H.

Biological aspect		Female			LSD 0.05	Male			L.S.D. at0.05
		Diet				Diet			
		Dry yeast granule	Wheat germ	*F. oxysporum*		Dry yeast granule	Wheat germ	*F. oxysporum*	
Inc. period		1.000±0.05^{a}	1.175±0.07^{ab}	1.275±0.08^{a}	0.1902	1.0± 0.06^{b}	1.125± 0.08^{ab}	1.21± 0.07^{a}	0.1758
Larva	A	0.375±0.04^{b}	0.425±0.05^{b}	0.575±0.04^{a}	0.1425	0.35±0.04^{b}	0.4± 0.04^{b}	0.57± 0.05^{a}	0.1456
	Q	0.228±0.01^{b}	0.296±0.03^{b}	0.475± 0.02^{a}	0.08404	0.216± 0.01^{b}	0.288± 0.04^{ab}	0.36± 0.04^{a}	0.0840
Protonymph	A	0.325±0.04^{b}	0.425±0.06^{b}	0.8± 0.07^{a}	0.1732	0.318± 0.04^{b}	0.4± 0.07^{b}	0.74± 0.09^{a}	0.2080
	Q	0.220±0.01^{b}	0.26±0.03^{b}	0.375± 0.04^{a}	0.08913	0.2± 0.01^{b}	0.205± 0.02^{b}	0.34± 0.03^{a}	0.0594
Tritonymph	A	0.525±0.07^{a}	0.55± 0.06^{a}	0.6± 0.04^{a}	0.1572	0.45± 0.06^{a}	0.525± 0.06^{a}	0.58±0.06^{a}	0.2037
	Q	0.300± 0.02^{a}	0.36± 0.04^{a}	0.35± 0.04^{a}	0.1029	0.226±0.19^{b}	0.325±0.04^{a}	0.35± 0.03^{a}	0.0728
Total immature		1.973±0.09^{c}	2.316±0.10^{b}	3.175± 0.08^{a}	0.2707	1.76±0.11^{b}	2.143±0.13^{b}	2.79± 0.16^{a}	0.4427
Life cycle		2.973± 0.12^{c}	3.491± 0.11^{b}	4.45± 0.13^{a}	0.3439	2.76± 0.14^{b}	3.268± 0.13^{b}	3.99± 0.18^{a}	0.5146
Longevity		18.5± 0.52^{c}	22.33± 0.33^{b}	24.27± 0.79^{a}	1.871	20.3±0.56^{b}	23.50± 0.76^{a}	25.2± 0.66^{a}	1.838
Life span		21.47±0.55^{b}	25.82±0.36^{a}	26.13± 0.79^{a}	1.925	23.06± 0.72^{c}	26.77±0.80^{b}	29.19± 0.69^{a}	2.034

A = Active stage, Q = quiescent stage

Means in each columns followed by the same letter are not significantly different at P ≤ 0.05% ± Standard error.

Table (2): Effect of different diets on *H. mahunkai* female longevity and fecundity at 27 °C ± 2 and 85 % ± 5 R.H.

Biological aspect	Diet			L.S.D$_{0.05}$
	Dry yeast granules	Wheat germ	*F.oxysporum*	
Pre-oviposition Period	0.600± 0.05^{a}	0.525± 0.04^{a}	0.675± 0.07^{a}	0.1654
Oviposition period	14.200± 0.42^{c}	17.500±0.43^{b}	19.100± 0.77^{a}	1.584
Post-oviposition Period	3.700± 0.3^{a}	4.300± 0.26^{a}	4.500± 0.34^{a}	0.9536
Generation	3.573±0.14^{c}	4.016± 0.13^{b}	5.125± 0.17^{a}	0.1305
Fecundity	181.000± 5.26^{a}	158.500± 5.68^{b}	144.500± 3.02^{b}	14.83
Daily Rate	12.800±0.39^{a}	9.066± 0.27^{b}	7.638± 0.24^{c}	0.8261

Means in each columns followed by the same letter are not significantly different at P≤ 0.05% ± standard error.

Abou El-Atta *et al.* (2014) who mentioned that the life cycle of *C. manure* durated 7.42 days for female and tall days for male days at 30°C; Eraky (1987) when reared *C. berlesei* (Mich.) on yeasted *Dorosophila*, the life cycle lasted 7.5 days at 26°C; Woodring (1969) stated that life cycle of *Caloglyphus anomalus* averaged 6.5 days at 23°C; whereas, Walia and Mathur (1998) indicated that *Tyrophagous putrescentiae* (Schrank) female life cycle durated 13.12 days when reared on juvenile of root the knot nematode (*Meloidogyne javanica*). Chmielewski (2000) reported that female *C. berlesei* life cycle was 19.90 days when fed on bee-bread, while in (2003) he found that its life cycle decreased to 17.7 days when reared on buck wheat sprouts at 20°C and 95-100% R.H. Also, Eraky and Osman (2008 b) reported that female and male *C. manuri* (Mich.) life cycle durated 10.40 and 8.10 days, respectively when reared on *Meloidogyne* sp. at 25 °C.

Adult longevity:

Longevity of females and males of *H. mahunkai* varied when fed on the different experimental food where significantly differences were recorded when fed on *F. oxysporum* took the longest period 24.270 days. This period changed to 22.330 and 18.500 days when fed on wheat germ and dry yeast granules, respectively with L.S.D. at 0.05 level = 0.3439.while, for males no significant differences between individuals when fed on wheat germ and *F. oxysporum* but it shortest when fed on dry yeast granules, it registered 23.50, 25.20 and 25.20 days. These results illustrated that males lived longer than female. Similar data obtained by Abou El-Atta *et al.* (2014) who stated that the adult female lived for 27.20, 20.55 and 16.95 days while male lived for 16.85, 18.40 and 9.30 days20, 25 and 30°C, respectively. Szlendak and Boczek (1992) showed that males of *Acarus siro* lived longer than females, since female lived about 15 days and male about 20 days at 25°C and 85 %R.H. Moreover, Woodring (1969) recorded that *C. anomalus* average female lived for 23.4 and 18.5 days when fed on meal worms and yeast, respectively. Eraky and Osman (2008) stated that *C. manure* female lived 15.70, 11.60 and 17.80 days when fed on yeast, dry cheese and *Meloidogyne* sp., respectively.

Pre-oviposition, oviposition and post-oviposition periods:

Table (2) cleared that, *H. mahunkai* female began to deposit eggs after 0.600, 0.525 and 0.675 days when fed on dry yeast granules; wheat germ and *F. oxysporum*, respectively. Statistical analysis showed no significant differences between pre-oviposition period when reared on the food mentioned above with L.S.D. at 0.05 level = 0.1654.

The same table illustrated that, the oviposition period greatly increased when the mites fed on *F. oxysporum* (19.1 days) than on wheat germ (17.500 days) and dry yeast granules (14.200 days). Statistically, obtained data showed significant deference between individuals when fed on same trend of food with $L.S.D._{0.05}$ = 1.584. These results resemble **Gerson** *et al.* (1983) who examined the oviposition rates of *R. robini* grown on different diets and temperatures.

Life span:

Accordingly, the results in table (1) cleared that, *H. mahunkai* life span of was affected by the types of food. No significant differences in the life span of females fed on wheat germ and *F. oxysporum* (25.820, 26.130 days) while it significantly.

The statistical analysis in the same table showed there are significant differences on the life span between males when fed on dry yeast granules; wheat germ and *F. oxysporum* (23.06; 26.77 and 29.19 days, respectively). This result is supported by similar results on the same sub-order mentioned by Stearns, (1992) who illustrated the variation in the duration of each developmental stage and differences in transformation rates may be the result of the interplay between several environmental variables such as diet.

Female fecundity:

The diets suitability affected the number of deposited eggs by *H. mahunkai* adult. No significant difference was found between individuals fed on Wheat germ and *F. oxysporum* 158.500 and 144.500 eggs, respectively. However, when the mites fed on dry yeast granules the number of deposited eggs increased (181.000 eggs).

Gerson *et al.* (1983) reported that at 27 ^{o}C *R. robini* females grown on peanuts laid 693 eggs per female over 40 days while those grown on garlic laid an average of 400 eggs per female over 31 days. Gravid females can carry a variable number of eggs (Woodring, 1969) which are laid one at a time and in a random fashion (Garman, 1937; Woodring, 1969). Oviposition is affected by many factors, including temperature and food quality. Woodring (1969) recorded that *C. anomalus* average female laid 930 and 545 eggs when fed on mealworms and yeast, respectively. Eraky and Osman (2008 b) stated that *C. manure* female of laid 601.40, 535.00 and 159.10 when fed on yeast, dry cheese and *Meloidogyne* sp., respectively. In 1987, Eraky found that *C. berlesei* deposited an average of 755.7 eggs in an average 15.9 days. Walia and Mathur (1998) found that *T. putrescentiae* (Schrank) female laid an average of 171.40 eggs when reared on juvenile of root the knot nematode (*M. javanica*). In 2000, Chmielewski showed that mean total deposited eggs per female of *C. berlesei* was 221.70 when fed on bee-bread where as in 2003, he recorded that its fecundity averaged 237.4 eggs when reared on buckwheat sprouts.

Hypopal stage

Hypopial stage of ***H. mahunkai*** did not appear at any time under any condition. This resembled the findings of **Eraky**, (1992). **Hughes** (1976) who observed this result on *T. putrescentiae* (Schrank).

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