

Effect of Starvation on Some Biological Aspects of *Steatoda triangulosa* Walckenaer, (Araneae: Theridiidae)

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ABSTRACT

Steatoda triangulosa Walckenaer was reared on *Tribolium confusum* (Duv.) larvae under laboratory conditions (23-35°C and 46-60% R.H.) to study the effect of starvation periods on spiderlings and adults. For spiderlings: "immature stages" these were starved for 1, 2, 3 weeks and fully starved immediately after hatching from eggs. Results showed that only spiderlings which starved for one week could complete its life span, while spiderlings which starved for 2, 3 weeks and fully starved couldn't complete their life cycle and also couldn't enter adult stage. For adults: females and males were partially starved for four different starvation periods of 1, 2, 3 weeks and fully starved immediately after last molting. Fully starved females couldn't enter their oviposition period. Adult females which starved for one week was deposited the highest number of oothecae with an average of 5.83 days compared with 7.2 days for satiated females.

Keywords: *Steatoda triangulosa*, Starvation, Biological aspects

INTRODUCTION

Steatoda triangulosa (Walckenaer) is a predominant species in crops at Fayoum government, the biological aspects was studied under different temperature and relative humidity (Rahil, 1988 & 2001 and Mahmoud, 2004). Under starvation conditions, adult survival times were studied and they were averaged 208 days for the wolf spider, *Lycosa lenta*, (Hentz) and 276 days for the cribellate web-builder, *Filistata hibernalis* (Hentz). Potential adult life spans for fed individuals were estimated to be 305 days for *L. lenta* and several years for *F. hibernalis* (Anderson, 1974). While Lowrie, 1980 mentioned that *Loxosceles laeta* (Nicolet) lived under conditions of various amounts and some variety of food and were fed fairly regularly every several days. The effects of starvation on the survival period and the respiratory rate in adults of a wolf spider, *Pardosa astrigera* (L. Koch) was investigated. Adult males and females of *P. astrigera* could survive for a long time; 28.8±2.7 days and 54.4±18.9 days, respectively, without any food. The longevities shown here were 73.8% for males and 78.6% for females of those of well-fed spiders, indicating that *P. astrigera* adults have a strong tolerance to starvation (Koichi Tanaka and Yosiaki Itô, 1982). Food deprivation tests indicate that most sub-adult and adult female *Latrodectus hasselti* (Thorell) spiders would be able to endure long periods of starvation if incarcerated in cargo. The data showed that, under appropriate conditions, sub-adults survive for up to 160 days and some adults for more than 300 days. Even after 2-3 months without food, most spiders recover when fed (Forster and Kavale, 1989). Hungry spiders may be more voracious than well-fed spiders only over longer time periods, since hungry spiders may spend more time handling their first prey items than well-fed spiders and also the higher number of prey killed by well-fed spiders over a 24-h period of spider-prey interaction probably occurred due to their greater weights than hungry spiders (Marcelo, *et al*, 2006)

So, the aim of the current study was to investigate the influence of starvation on some biological aspects of *S. triangulosa* and to determine if observed changes in these aspects reflect differences in the spider's ability to develop.

MATERIALS AND METHODS

Rearing of spiders and flour beetles:

The basic stock of spider was obtained from the egg sacs laid by adult female spiders collected from farms in El-Fayoum governorate. A stock culture of the spider *Steatoda triangulosa* (Walckenaer) fed on different instar larvae of the flour beetle *Tribolium confusum* (Duv.) was maintained in the laboratory in 100 Petri dishes (10 cm), and kept under laboratory conditions (23-35°C and 46-60 % R.H.). The adult beetles were transferred from old flour samples to maintain culture of prey.

Formation of study groups:

1-Spiderlings starvation:

One hundred individuals of *S. triangulosa* were divided in to five groups. First group considered satiated individuals and other four groups were starved for different starvation periods (1, 2, 3 weeks and fully starved). All of them were starved after hatching from egg.

2-Adults starvation:

Adults of *S. triangulosa* were starved after the last molt and the previous technique which used for spiderlings was used for adults. Females were observed to obtain number of egg sacs/female, % hatch, the periods of pre oviposition, oviposition and post oviposition while males were observed to obtain longevity.

Data were analyzed statistically by univariate variance analysis (ANOVA, Duncan test; Spss, 20.0 -for windows.

RESULTS AND DISCUSSION

The effects of different starvation periods on the survival and development of *S. triangulosa* were evaluated in both types of starvation (spiderlings and adults starvation for 1, 2, 3 weeks and fully starvation. Spiders remained fully mobile and were able to spin webs and catch prey until death. Additional observations were carried out in order to clarify biological aspects of this spider influenced by starvation.

1- Spiderlings starvation:

A) Durations of spiderlings:

As shown in Table 1, about 100 individuals of spiderlings were tested for starvation which divided into five groups. The first group was provided with sufficient food and considered a control which called

satiated individual; these individuals were passed through four instars to complete the duration of immatures; the instar periods were 7.0, 5.4, 8.1 and 7.7 days for female, respectively. Males were passed through 9.6, 6.6 and 8.5 days, respectively. The total immature period of female was prolonged (28.2) days compared with that of male (24.7) days.

Individuals which starved for one week also recorded 4th and 3rd instars for female and male, respectively. The total immature period of female and male was prolonged compared with that of satiated individuals and were recorded 44.83 and 34.6 days for female and male, respectively. Individuals which starved for two and three weeks were passed through 3rd instars then died compared with satiated and which starved for one week were reached to adulthood and complete their life span. The total immatures were increased with increasing starvation periods where these periods ranged between 34.6, 65.26 days.

Table 1. Durations of *S. triangulosa* spiderlings of different starvation periods.

Starvation period	Sex	Spiderlings Mean±SE				Total
		1 st	2 nd	3 rd	4 th	
Satiated	♀	7.00±0.45d 5-10	5.40±0.34c 4-7	8.10±0.14c 6-10	7.70±0.59 5-11	28.2±1.01d 24-33
	♂	9.60±0.40cd 8-11	6.60±0.45bc 5-9	8.50±0.62c 6-12	----- -----	24.70±0.66d 21-28
1 week	♀	11.50±0.43bc 10-13	9.00±0.73bc 7-12	9.66±0.71c 8-13	14.66±1.63 10-20	44.83±1.81cd 40-53
	♂	11.60±0.60bc 10-13	11.20±0.49bc 10-13	11.80±0.66c 10-14	----- -----	34.60±0.40d 34-36
2 weeks	---	13.22±.86b 10-20	23.44±4.38a 12-50	28.75±6.57b 15-40	----- -----	65.26±5.93bc 11-70
	---	13.67±0.75b 8-21	13.28±2.91abc 10-43	36.00±11.47b 12-88	----- -----	62.75±14.65b 11-124
3 weeks	---	18.73±0.94a 14-23	17.00±2.17ab 12-27	65.00±8.66a 50-80	----- -----	100.73±3.67a 92-103

B) Food consumption of spiderlings:

As shown in (Table 2), female first instar was consumed 7.7 individuals of prey compared with 4.33 and 5.2 preys during starvation periods of one and two weeks while in three weeks starvation period all individuals were molted and reached the 2nd instars before feeding. Food consumption of male ranged between 4.2 and 8.2 preys

according to starvation period In the 2nd instars, number of prey consumed were increased gradually during satiated, one and two weeks of starvation to record 7.6, 9 and 28.57 preys for females and was decreased with 3 weeks starvation recorded 9.87 preys according to the continuity of starvation during this instar.

For males, prey consumed ranged between 6.3 – 9.8 preys with periods of satiated and one week starvation. In the 3rd instar, the same trend of consumed prey was obtained. In additional to the consumed prey with three weeks period was 31.71 preys. Only satiated and individuals which starved for one week were reached to 4th instar and adult periods and their periods ranged between 12.3 and 15.67 preys. The total number of prey consumed during different immature stages was 39.3, 39.17, 62.27 and 41.58 preys, respectively.

Table 2. Food consumption of *S. triangulosa* spiderlings of different starvation periods.

Starvation period	Sex	Spiderlings Mean±SE				Total
		1 st	2 nd	3 rd	4 th	
Satiated	♀	7.70±0.56a 4-10	7.60±0.52b 5-10	11.70±0.77b 7-14	12.30±1.26 8-21	39.3±1.63b 29-47
	♂	8.20±0.53a 6-11	6.30±0.51b 3-8	9.20±0.59b 6-12	----- -----	23.7±0.68c 19-27
1 week	♀	4.33±0.49b 3-6	9.00±0.85b 7-12	10.17±1.05b 11-22	15.67±1.8 11-22	39.17±1.74b 32-44
	♂	4.20±0.37b 4-6	9.80±0.37b 9-11	10.80±0.73b 8-12	----- -----	24.80±0.73c 24-26
2 weeks	---	5.20±0.31b 4-6	28.57±4.62a 9-54	28.50±4.79a 17-39	----- -----	62.27±3.79a 30-94
	---	----- -	9.87±3.75b 2-33	31.71±8.31a 9-81	----- -----	41.58±13.27a b 11-89

C) Adult durations and food consumption:

The obtained results in (Table 3), showed that the individuals of spiders which reached to adulthood were lasted 113.6 and 104.2 days for satiated females and males compared with 102.5 and 46.2 days, respectively for females and males when their spiderlings starved for one week.

From previous data we can conclude that longevity and life span were prolonged compared with that of males also food consumption of females was more than that of males. Life span ranged between 130-156 days for female and 77-86 days for male.

Table 3. Durations and food consumption of *S. triangulosa* starved adults which starved during spiderlings period.

Starvation periods		Adults Mean ±SE						
		Pre oviposition	Oviposition	Post oviposition	Longevity		Life span	
					♀	♂	♀	♂
Durations	Satiated	10.5±0.45 8-13	69.2±2.16 55-77	33.9± 2.27 25-44	113.6±2.92 98-128	104.2±5.38 80-134	141.8±2.75 124-155	128.9±9.7 106-203
	1 week	13.50±0.62 12-16	52.00±2.82 41-60	37.00±2.67 30-46	102.5±3.05 88-107	46.20±1.39 35-50	147.33±4.41 130-156	80.8±1.62 77-86
Food	Satiated	19.7±1.65 15-30	138.7±5.85 115-159	49.5±3.15 35-65	207.9±8.19 168-240	98.4±6.89 61-135	247.2±8.57 207-280	122.1±7.02 85-162
	1 week	16.16±1.51 11-20	74.00±6.46 49-89	39.33±4.22 28-56	129.5±3.41 79-100	42.20±2.52 35-50	131.17±4.07 117-144	67.0±2.77 59-75

3 - Adult starvation:

A) Durations of Adults:

As shown in (Table 4), adult starvation was obtained in five cases (satiated, starved for one, two, three weeks and fully starved). Significant differences were obtained between different cases; female longevity was gradually decreased from 113.6 days in satiated to reach 51.1 days in fully starved while male longevity ranged between 35 to 104.2 days. Significant differences were obtained between

different starvation periods which correlated with durations of individuals

In these observations of starvation periods, it was noted that adult males died sooner than females. No males survived more than 76.9 days while females survived for 95.9, perhaps males lack to store nutrient to get them during starvation periods. More observations in the laboratory also indicated that adult males of *S. triangulosa* were more difficult to keep alive for normal longevity period, even if provided with prey after starvation period.

B) Food consumption of adults:

Food consumption of female ranged between 93.3 and 207.9 preys according to starvation period while food consumption of male ranged between 56.2 and 98.4 preys according to starvation period as shown in Table 4.

In this respect, spider's predation potential, estimated as food consumption, varied with stage of development and type of food, Mahmoud, 2004, also Anja, et al, 2010 examined that starvation weakens individuals more than in better conditions.

Table 4. Durations and food consumption of *S. triangulosa* starved adults.

Starvation period	durations mean±SE						food consumption mean±SE					
	Pre ovi position		Ovi position		Post ovi position		Pre ovi position		Ovi position		Post ovi position	
	Longevity		Longevity		Longevity		Longevity		Longevity		Longevity	
				♀	♂					♀	♂	
Satiated	10.5±0.45c 8-13	69.2±2.1a 55-77	33.9±2.2a 25-44	113.6±2.9a 98-128	104.2±5.38a 80-134	19.7±1.65 a 15-30	138.7±5.8a 115-159	49.5±3.1a 35-65	207.9±8.19a 168-240	98.4±6.89a 61-135		
1 week	14.6±0.54d 12-17	51.8±0.8b 48-56	29.5±0.8b 26-34	95.9±1.37b 89-103	76.9±3.12b 59-89	7.5±0.34 b 6-9	114.4±8.6b 87-165	41.1±2.1b 32-54	150.7±11.59b 106.1±5.84c	74.0±2.45b 60-84		
2 weeks	22.5±0.82c 18-26	29.9±0.4c 26-34	22.5±0.62c 20-26	74.9±1.1c 68-80	55.7±3.04c 38-69	8.8±0.55 b 6-11	47.9±1.97c 39-56	21.0±1.2c 16-27	106.1±5.84c 86-140	62.0±2.16c 51-70		
3 weeks	29.3±0.82b 25-34	22.8±0.7d 19-26	19.0±0.63c 16-22	71.1±1.52c 63-78	52.00±3.09c 39-67	5.8±0.65 b 5-12	43.2±2.55c 31-55	22.7±2.9c 10-43	93.3±4.12c 75-117	56.2±2.96c 41-69		
Fully starved	51.1±2.67a 40-65	-----	-----	51.1±2.67d 40-65	35.00±1.18d 30-40	-----	-----	-----	-----	-----	-----	

Effect of starvation on *S. triangulosa* fecundity:

The result represented in Table 5, indicated that the fecundity of *S. triangulosa* was influenced by starvation periods and significant differences between treatments were obtained except between starved adults for one and two weeks. Fecundity of satiated adults was 7.2 sac/female, ranged between 6-10 sacs/ female then decreased, also the same trend was obtained with number of eggs / female where 69.6 eggs/sac was considered the highest number of eggs and the least was 12.9 eggs/sac ranged 9-17 eggs/sac for adult starved for three weeks. Fully starved individuals couldn't lay any egg sacs.

In this respect, Mahmoud, 2004, mentioned that insufficient feeding significantly influenced longevity of females and males of *Cheiracanthium jovium* Denis. Fecundity of females was reduced and the effect of starvation period was well pronounced.

Table 5. Fecundity of *S. triangulosa* females influenced by different starvation periods.

Starvation periods	No./sac/female	No. eggs/sac	%Hatchability
Satiated	7.2±0.59a 6-10	69.6±3.98a 51-91	47.09±3.79a 34-70
Immature starved	6.83±0.54b 5-9	66.33±1.74a 59-71	36.11±3.84ab 21-50
Adult starved 1week	5.8±0.59b 3-9	42.7±2.7b 30-55	35.84±2.45ab 25-48.78
Adult starved 2weeks	4.1±0.38c 2-6	27.4±1.63c 19-35	33.19±3.96b 24-47
Adult starved 3weeks	2.1±0.31d 1-4	12.9±0.72d 9-17	0.00

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تأثير التجويع على بعض المظاهر البيولوجية للنوع ستيودا ترائ انجيلوزا شيرين حسن محمد صفر و ماهر فؤاد رمضان محمود كلية الزراعة - وقاية النبات - جامعة الفيوم

يعتبر النوع ستيودا ترائ انجيلوزا من الانواع المنتشرة على المحاصيل المختلفة في محافظة الفيوم وقد تم تربيته على يرقات خنافس الدقيق المتشابهة في المعمل تحت الظروف المعملية من حرارة تتراوح بين 23-30 درجة مئوية ورطوبة نسبية 60-70% لدراسة تأثير التجويع على المظاهر البيولوجية له وقد تم تقسيم الافراد الى مجموعات مختلفة في فترة التجويع وهي (مجموعة الافراد المتغذية باستمرار- مجموعة الافراد المجموعة لمدة اسبوع - اسبوعين - 3 اسابيع - باستمرار) لكل من الاطوار الغير الكاملة والاطوار الكاملة ذكور واناث. وقد اظهرت نتائج الدراسة ان الافراد المجموعة في فترة الاطوار الغير كاملة لم تستطع استكمال دورة حياتها ما عدا المجموعة لمدة اسبوع واحد. اما الاناث المجموعة طيلة حياتها لم تستطع وضع البيض وكان اعلى معدل لوضع اكياس البيض في الاناث المجموعة لمدة اسبوع وكان متوسط اكياس البيض 83,5 مقارنة بالافراد المتغذية حيث وضعت 2,7 كيس بيض. مما سبق تبين تأثير التجويع على المظاهر البيولوجية لهذا النوع