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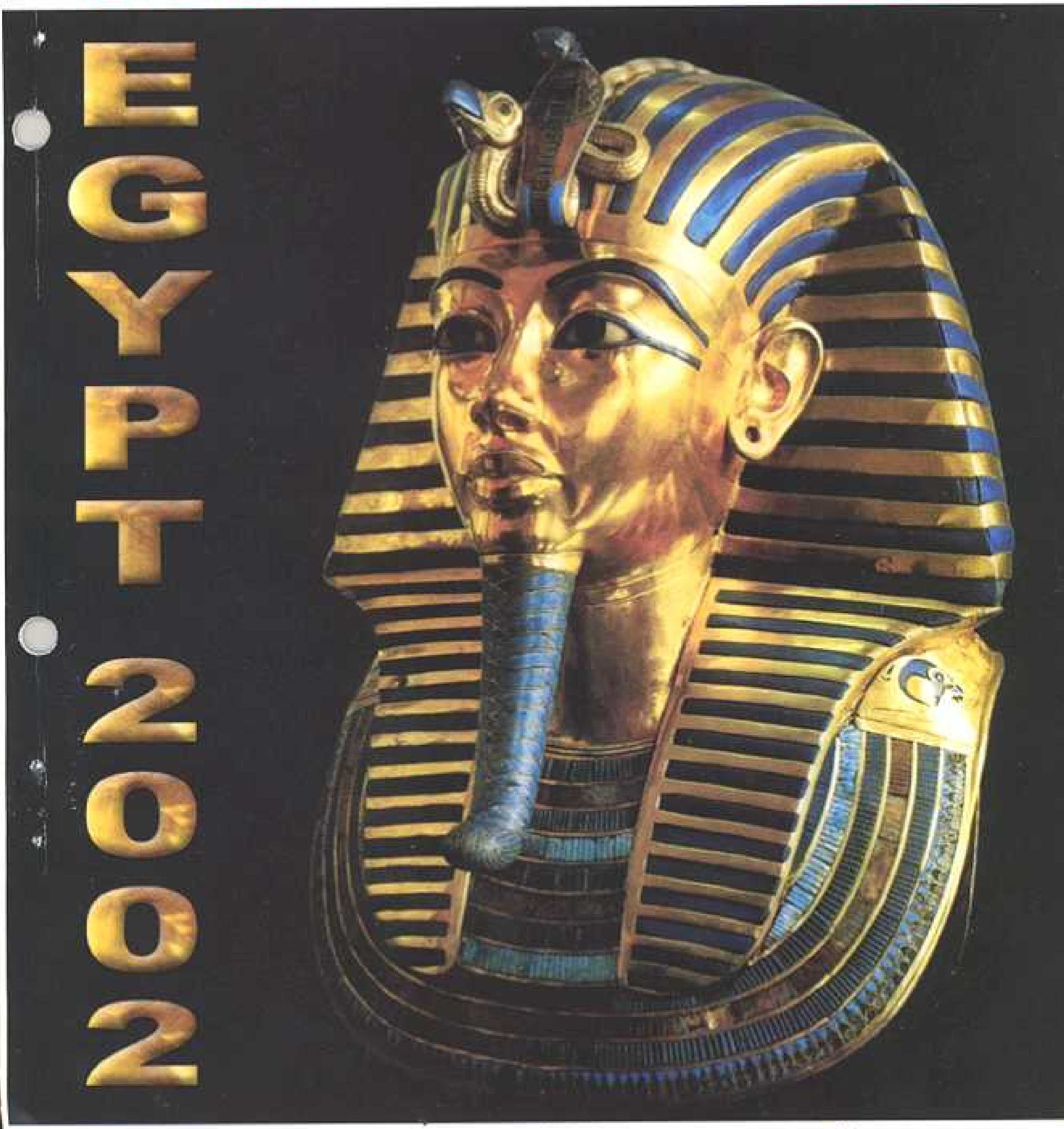

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EFFECT OF THE AMOUNT OF FOOD GIVEN TO THE LARVAE ON THE LIFE CYCLE OF PARASARCOPHAGA (LIOPYGIA) RUFICORNIS (F.)

By

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Abstract

The effect of food limitation upon developmental time, survival, weight, longevity and fecundity of adults was studied for *Parasarcophaga (Liopygia) ruficornis* (F.) at 25°C, 60-65% RH and a 15:9 (L:D)h photoperiod, and offered food in 10 different weights (10-100gm/ 100 larvae). The deveopmental time of larvae, and pupae decreased with the decrease in the amount of larval food for both sexes. Survive of the larval stage was not affected by decreasing the amount of larval food, while the pupal survival was significantly increased. The correlation between pupal weight and survival was significantly increased with the decreasing pupal weights. Pupal and adult weights decreased with the decrease in the amount of minced beef given as larval food for both sexes. There is no significant correlation between flies weights and longevity for both sexes. Females lived longer than males at three different weights. Fecundity of the medium-sized adult showed a higher average in number of larvae per female than the large or small- sized ones.

Introduction

The flesh-fly *Parasarcophaga (Liopygia) ruficornis* (F.) has a worldwide distribution. It is found in Oriental Region (China, India, Malaysia, Nepal, Pakistan, Philippines, Socotra, Somatra, Taiwan), Afrotropical Region (East Africa, Madagascar), Australian Region (Mariana Is. Moluccas, New Guinea Samoa, Hawaii Is.), Neotropical Region (Brazil), Palaearctic Region (Ryukyu Is., Japan). Now it is common in Saudi Arabia (Sugiyama et al., 1988; Sugiyama, 1989; Amoudi et al., 1992; Amoudi, 1993). It causes cutaneous myiasis in dogs, horses, mules and man (Zumpt, 1965). The biology and behaviour of *P. ruficornis* were briefly studied by Versia (1963), Shukla and Singh (1970; 1972), Nandi (1980) and Amoudi et al. (1992; 1994). No doubt, some species of insects are valuable to man as honeybees. Others are utilized in experimental activities. Generally speaking, the food available for the larval stages have marked effect on the biological activities of the other stages (Keiding and Arevad, 1964; Barposa and peters, 1970; Lawton and Hassell, 1981; Kelany *et al.*, 1989; Amoudi *et al.*, 1993 and Al-Misned *et al.*, 1999).

The present study aimed to throw some light on certain biological parameters, i.e. developmental time, pupal weight, and weights, longevity and fecundity of adult of *Parasarcophaga ruficornis* (F.) when the larvae were given different amounts of minced beef .

Material and Methods

The newly deposited first-instar larvae of *Parasarcophaga ruficornis* were obtained from established colony in Department of Zoology, King Saud University. The colony was maintained at 25±1°C, 60-65% RH, and a 15:9 (L:D)h photoperiod (Amoudi *et al.*,1992). The larvae were classified into ten groups, each of 100 larvae. Each group was kept in separate insect-proof cage and given a different amount of minced beef. The first group was given 100gm of ground beef, the second was given 90 gm and so on. The last group was given only 10gm of minced beef. All groups were kept in the same laboratory conditions under close observations. Two replicates of the experiment were used and the reported results were the average values.

Larvae were checked during wandering phase through the sawdust strata at 12-h. intervals till pupation. The larval developmental time was recorded. The resulting pupae were daily collected from each group, to be weighed by the Ac-100 balance (Mettler Instrument, Zurich, Switzerland; accuracy, 0.1mg). The transferred to new labeled kept insect-proof cages. The pupal developmental time was recorded. On adult emergence, flies were immobilized by chilling for 3 minutes according to Parrish and Bickely (1966), sexed and weighed.

Longevity and fecundity: Newly emerged males (25) and females (25) from each cage were randomly selected and transferred to labeled insect-proof breeding cages. Flies were offered cubes of sugar, water-soaked cotton and minced beef. The minced beef was removed daily and examined for newly deposited larvae, which were removed to new breeding cages. The cubes of sugar, and water-soaked cotton were provided whenever indicated. Dead flies were removed daily, sex-identified and counted till the death of the last fly.

The mean number of larvae deposited per female was calculated. The life span of adults (males and females) was recorded.

Statistical analyses were conducted using the MINITAB computer program for all parameters. For universality models significance of the correlation coefficient (r) was tested with analysis of variance (Edwards, 1985). Student's t test was used to compare males and females for some biological parameters.

Results

The results are shown in tables (1,2,3 &4) and figure (1).

Discussion

In the present study, the total larval and pupal developmental time (table 1) decreased when decreasing the amount of larval food. There was highly significant correlations between total larval developmental time and the amounts of minced beef ($r = 0.90$, $p<0.001$) for both sexes. Also, there was a significant correlation between the amounts of food given to the larvae and the pupal developmental time ($r = 0.73$, $p<0.05$) for males and ($r = 0.75$, $p<0.05$) for females. The mean total developmental time

Table 1. Developmental time (days) of *P. ruficornis* life stages given different amount of minced beef .

Minced beef (gm)/group	Stages, Mean ± SE						
	Larva		Pupa		Total		
	♂	♀		♀	♂	♀	♂ + ♀
100	7.0±0.11	7.0±0.12	13.0±0.08	12.8±0.11	20.0±0.14	19.8±0.15	19.9±0.10
90	7.1±0.07	7.1±0.05	13.1±0.09	13.0±0.12	20.2±0.11	20.1±0.12	20.2±0.08
80	6.1±0.09	6.3±0.08	13.3±0.11	13.0±0.12	19.4±0.12	19.3±0.16	19.4±0.10
70	6.1±0.10	6.3±0.12	13.2±0.15	13.3±0.12	19.4±0.19	19.6±0.16	19.5±0.13
60	5.9±0.07	5.9±0.12	13.2±0.12	12.8±0.14	19.1±0.13	18.7±0.15	19.0±0.10
50	5.8±0.10	6.2±0.18	13.3±0.11	12.8±0.14	19.1±0.16	19.1±0.23	19.1±0.14
40	5.3±0.07	5.2±0.06	13.1±0.06	13.2±0.06	18.4±0.08	18.2±0.07	18.3±0.06
30	4.9±0.08	5.2±0.11	12.7±0.10	12.3±0.09	17.6±0.11	17.5±0.12	17.6±0.08
20	5.5±0.07	5.4±0.08	12.4±0.09	12.3±0.11	17.9±0.11	17.7±0.15	17.8±0.09
10	5.3±0.07	5.5±0.09	12.0±0.07	11.6±0.09	17.3±0.07	17.2±0.10	17.3±0.06
Overall Mean ± SE	5.9±0.23	6.0±0.22	12.9±0.14	12.7±0.16	18.8±0.32	18.7±0.32	18.9±0.32

Table 2: Survival of the immature stages and adult sex ratio of *P. ruficornis* given different amount of minced beef.

Minced beef (gm)/group	Survival %			Adult sex ratio
	Larva	Pupa	Total	♂ : ♀
100	87.0	80.5	70.0	1 : 0.71
90	90.5	78.5	71.0	1 : 1.12
80	86.0	80.8	69.5	1 : 0.85
70	91.5	87.4	80.0	1 : 0.82
60	93.0	76.3	71.0	1 : 0.69
50	94.0	92.0	86.5	1 : 0.71
40	83.5	94.6	79.0	1 : 0.93
30	93.0	95.7	89.0	1 : 0.97
20	87.0	95.9	83.5	1 : 0.70
10	85.5	98.8	84.5	1 : 0.74
Overall Mean ± SE	89.1±1.18	88.1±2.65	78.4±2.37	1 : 0.82

Table 4: Longevity and fecundity of adult stage of *P. ruficornis* at different weights.

Adult wt. (mg)		Adult longevity/days		Fecundity	Minimum Prelarviposition/ day
♂	♀	♂	♀	Larva / ♀	
93.6	92.8	25.8±0.89	27.3±0.96	42	13
83.9	80.9	23.3±1.18	27.8±1.21	48	13
57.3	56.2	26.1±1.20	29.4±1.29	33	18

Table 3. Weights of pupal and adult (Mean ± SE) of *P. ruficornis* at different ground beef weights.

Minced beef (gm)/group	Pupal wt. (mg)	Adult wt. (mg)			Total biomass/ jar (gm)
	♂ + ♀	♂	♀	♂ + ♀	
100	160.1±0.59	93.6±1.25	92.8±1.94	93.2±1.08	6.524
90	155.0±0.40	92.4±0.71	86.9±1.30	89.6±0.82	6.361
80	153.3±0.50	92.1±1.35	89.8±2.38	91.1±1.31	6.331
70	152.1±0.41	93.8±0.69	85.8±1.48	90.2±0.88	7.216
60	152.4±0.42	90.9±0.84	88.4±0.91	89.9±0.63	6.382
50	149.4±0.55	94.4±1.35	91.2±1.58	93.1±1.03	8.052
40	136.9±1.58	83.9±0.75	80.9±2.23	82.5±1.15	6.517
30	108.1±1.10	68.3±1.73	60.6±1.29	64.6±1.16	5.749
20	87.8±0.10	57.3±1.10	56.2±2.07	56.8±1.07	4.742
10	51.0±0.29	34.7±0.76	30.4±0.92	32.9±0.63	2.780
Overall Mean ± SE	130.6±11.5	80.1±6.43	76.3±6.50	78.4±6.44	6.065±0.454

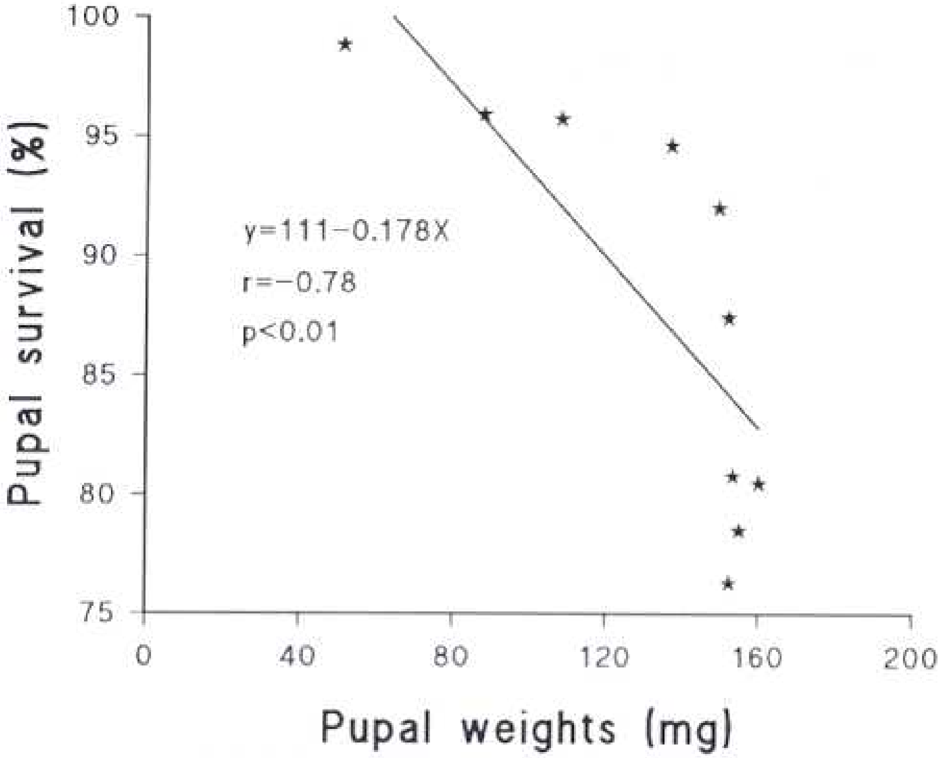

Fig. 1. The correlation between pupal weights and percentage of pupal survival of *P. ruficornis*

(combined sexes) decreased when decreasing larval food(r =0.90, p<0.001). However, no significant differences (p>0.05) between the overall mean larval, pupal and total developmental time of both sexes. Larval duration was 35.2, 35.1, 32.0, 31.8, 31.1, 31.4, 28.4, 28.4, 30.9, and 31.2% and for pupae 64.8, 64.4, 68.0, 68.2, 68.4, 68.6, 71.6, 71.0, 69.7 and 68.2% of total developmental time for the ten amounts of food (levels between 100 and 10gm). The percentage duration of total developmental time for larvae decreased (r =0.75, p<0.05), but for pupae increased (r =-0.74, p<0.05) with the decrease of food amounts. Ullyet (1950), Kamal (1958), Sullivan and Sokal (1963) and Amoudi et al. (1993) reported that a critical food shortage tended to increase the duration of the larval stages in some dipterous flies. In the present study, when a food shortage was induced by decreasing the amounts to a fixed number of larvae (100), there was a marked decrease in the weights of larvae and developmental time. This was due to the increase in competition for shortage of food given. Such data are in agreement with those of Al- Misned et al. (1999). They found that the larval, pupal and total duration periods decreased when decreasing of

the amount of larval food. Also, Goodbrod and Goff (1990) reported that the total duration of the larval stage, decreased as a function of increasing larval population density per gm food. They added that the decreased of total larval developmental time may also be related to increase in temperature associated with the large number of larvae firing for feeding.
The present data revealed that survival of 100 larvae per group, reared on ten different amounts of food (Table 2) ranged between 83.5% and 94%. this type of did not reflect any decisive effect of larval survive. The overall mean reached 89.1%. The larval survival percentage seems to be slightly low (83.5%) in those given. 40gm food and attained its level maximum (94%) in those given 50gm. So, 50 gm/100 larvae represented the optimum amount of food for maximum larval survive. Statistical analysis (Table 2) revealed no significant correlation between all tested amounts of food and larval survive ($r = 0.13$, $p > 0.05$). The present findings are in agreement with those of Al- Misned et al. (1999). They found no significant correlation between amount of larval food weights and larval surviveof *B. cruentata*. The percentage of pupal and total survival time was significantly increased with decreasing the larval food ($r = -0.87$, $p < 0.001$) for pupae and ($r = -0.81$, $p < 0.01$) for total survival time. Pupal survive obtained in the first cages was lowest, it ranged between 76.3% and 87.4%. Then increasing with decreasing larval food to a maximum of 98.8% (10gm food/100 larvae). There was a relationship between pupal weight and survive, In general, pupal survive was significantly increased with decreasing pupal weights ($r = -0.78$, $p < 0.01$) (Fig. 1). This relationship in *P. ruficornis* is similar to that found in houseflies (Haupt and Busvine, 1968), *Drosophila melanogaster* (Sang, 1949; Miller, 1964) and *Ephydra cinerea* (Collins, 1980). Also, there was no significant correlation ($r = 0.22$, $p > 0.05$) between adult sex ratio and amounts of minced beef. So, the amount of larval food neither affected larval nor pupal sex determination. Similar findings were found in houseflies (Boggild and Keiding, 1958; Sullivan and Sokal, 1963).

Data (table 3) showed that a decrease in larval food resulted in a decrease of pupal weights. The correlation between amount of beef and pupal weight was significant ($r = 0.87$, $p < 0.001$).

The maximum mean weight of pupa reached 160.1mg in the amount of 100gm/100 larvae, whereas, the minimum one was 51.0 mg with 10gm/100 larvae. Such data is in agreement with those of Al- Misned et al. (1999), who found that decrease in amount of larval food of *B. cruentata* resulted in a decrease of pupal weight. Kelany et al. (1989) found that an increase in larval density of *P. argyrostoma* resulted a decreased of pupal weight. They also found difference between the weights of the control pupae of *Chrysomya albiceps* (10 larvae/ 50gm fish) and the heights density of 100 larvae/ 50 gm fish. Zaher and Moussa (1961) reported that the population density has a great influence on the weight of the pupae when the larval food is limited.

In the present study, the mean weight of adults followed the same trend as in pupae. The adult weights significantly decreased with decreasing the larval food ($r = 0.83$, $p < 0.01$) for both sexes. The maximum mean weight of males reached 94.4 mg with 50gm/100 larvae compared with a maximum mean weight of adult females, 92.8mg with100gm/100 larvae. Whereas, the minimal mean weight was 34.7 and 30.4 mg for males and females (10gm/100 larvae). The mean weights of males were slightly higher than that of females, but no significant differences ($p > 0.05$). The optimum pupal and adult weights, was with 50 and 100 gm/100 larvae. This agreed with that found in *B. cruentata* (Al-Misned et al., 1999), *P. argyrostoma and C. albiceps* (Kelany et al., 1989), houseflies (Sullivan and Sokal, 1963) and *C. megacephala* and *C. rufifacies* (Goodbrod and Goff, 1990).

In term of total biomass, 50gm of minced beef represent the best level (8.052gm) compared with (2.780gm) in10gm/100 larvae. The total biomass was significantly correlated with five amounts, between 50 and 10gm/100 larvae ($r = 0.99$, $p < 0.01$). It was clear that maximum total biomass was found at 50gm and minimum at 10gm food. The results are similar to those of Al-Misned et al. (1999) with *B. cruentata*, they found a positive correlation between the total biomass per beaker with the amount of larval food. Longevity (table 4) did not show a pronounced difference in survival of small flies, suggesting a slightly longer survival by the small flies than large and medium-sized flies in both sexes, but with no significant correlation between flies weights and longevity ($r = -0.35$, $p>0.05$) for males and ($r = -0.99$, $p>0.05$) for females. Females lived longer than males at three different flies weights ($p<0.05$). Haupt and Busvine (1968) reported no obvious difference in the survival time of large or small house flies. Collins (1980) demonstrated that the medium-sized *Ephydra cinerea* have longer life spans than large ones.

The minimum of pre-larviposition periods (table 4) increased (r -0.95) with decreased adult weights. Fecundity of medium-sized adult size gave higher number of larvae per female than the large or small-sized ones. Collins (1980) concluded that the fecundity is positively related to adult body mass (except in largest size classes). Such variation in longevity and fecundity indicates that largest flies suffer from physiological or structural defects that interfere with effective use of energy reserve.

It is concluded that, in *P. ruficornis*, pupal survival increases, but, larval and pupal developmental time, pupal and adult sizes and fecundity decrease due to larval food scarcity. Additional experiments are ongoing to determine the effect of food on the development and other essential biological parameters.

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