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The effect of different temperature on the viability and fertility of *Drosophila melanogaster*

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ABSTRACT

Many studies found that the temperature has affected the fecundity and fertility in the female of *Drosophila melanogaster*. In this study we used male of 2-3 days age old and female of 5-6 days age old for studies of temperatures on the male reproductive performance and female fitness traits. In related to be compared three temperatures from low (15°c) temperature middle temperature (22°c) and high temperature (29°c), results were analysed by SPSS software for getting mean value , ANOVA variation and correlation relationship. In this regard, females which exposure to high temperature, among of egg laid and offspring produce (fecundity and fertility, respectively) less than middle and low temperature, that these results were significant, *p value* <0.000, between male and female with temperature and also between fecundity and fertility. The results of correlation relationship are shown; there was a significant Pearson correlation between three temperatures (low, middle and high) with the rate of egg laid and egg hatchability.

Keywords: *Drosophila melanogaster*, female mating, Fecundity, Fertility.

INTRODUCTION

The temperature is important in life cycle of *Drosophila melanogaster*, this factor will determine physiological function and numerous mechanisms compensating for temperature variation (Cossins and Bowler, 1987; Precht *et al*., 1973; Leather *et al*., 1993). Temperature function also has been investigated and characterized for extreme conditions and tolerance of cold and heat stress. (Hoffmann and Parsons, 1991, 1997; Zatsepina *et al*., 2001; Hoffmann *et al.*, 2003). Parsons 1973 and David 1971, proposed that male flies by chronic exposure of hot temperature (29°c), the fertility was very less, however, these males after a few days at a lower temperature could recover fertility element. This phenomenon, also reported by (David *et al*., 1983). Temperature also plays an important role in reproductive performance and fitness components such as female fecundity, fertility and male mating ability in *Drosophila melanogaster*. It is critical condition at low and high temperatures. (Mckenzie, 1975; Parsons, 1978; Schnebel and Grossfield, 1986). The high temperature can exert evolutionary effect on the body size, genetically diverse. (David and Bocquet 1975; David *et al.* 1983; Lemeunier *et al*. 1986; Coyne and Beecham 1987;James *et al.* 1995), Also, there is evidence from laboratory studies of ectothermal condition that compared between cold and warm temperature. Cold adapted lines about oviposition and egg laid more than the warm adapted when reared at a common temperature, irrespective of whether the comparison is conducted in the warm or the cold environment. (Anderson 1966, 1973; Cavicchi *et al*. 1985, 1989; Partridge *et al.* 1994).

In the present study, the hypothesis effective of temperature on the reproductive performance, the temperatures evolved at lower , middle and warmer temperature that act on the female and male fitness traits were studied. In contrast, the females derived from cooler environment produced more eggs and also more offspring than females derived from warmer environments. Similar results also are shown in *Drosophila pseudoobscura* (Dobzhansky, 1935), *Drosophila melanogaster* (Tantawy and El Helw, 1970).These studies demonstrate adaptation flies in reared cold temperature more than warm temperature. Here we aimed, the effect of low, middle and warm temperatures on the rate of reproductive performance such as female egg laid, egg hatchability, and male mated performance in *Drosophila melanogaster* for stage of young days aged.

MATERIALS AND METHODS

Isofemale flies: The isofemale lines namely Oregan K obtained from the National Drosophila Stock Centre, Department of Zoology (UOM)-India. These flies were used to study of temperature effect on the male mating performance and female fitness components. The flies were cultured and using wheat cream agar medium at 70% humidity and relative temperature including, 15°c, 22°c and 29°c. Twenty flies quarter pint milk bottle (250 ml) were maintained using 12:12 hour light/dark cycle. These flies were kept in vial by separately male and female and aged as required for next experiments.

Exposure to different temperature: To test the effect of temperature on male mating ability and female fitness performances were used experiments in three different temperatures, including, 15°c, 22°c and 29 °c. The male and female flies after egg eclosion, immediately were separated male and female in new vials. The males at this study had 2-3 days age old for mating with virgin females that had 5-6 days old age. For studies of female components fitness, virgin males and virgin females were kept for 24 hours in the vial for mating with them. The components fitness such as egg laid and hatchability (fecundity and fertility, respectively), every three hours egg laid was recorded. The eggs laid in different temperatures were indicated for fecundity performance and also the produce of offspring was indicated for fertility components.

Statistical analysis: The percent of, female reproductive performance such as, fecundity and fertility were planned and analyzed by an SPSS software program (version 10.1) with the average number of eggs per female in the fifty replicates as dependent to variable age and fertility as dependent variable. These parameters were computed by mean value, one way ANOVA variation, regression and correlation index.

RESULTS

Fitness components: The fitness components were measured and recorded including, fecundity and fertility.

The effect of temperature on the fecundity: Fecundity in 15°c was measured, the female flies 5-6 days old age with 2-3 days male age after mating, the eggs laid were counted every day. Also in 22°c and 29°c, eggs were counted and recorded, in comparison with mean value is shown, the eggs laid in 15°c more number than 29°c and in 22°c rate of eggs laid, higher than other temperature (Table 1). The results also were compared by ANOVA variation in three temperatures. There were between three temperatures(15°c, 22°c and 29°c, respectively) with male age (2-3 days old aged)

and female age (5-6 days old aged) a significant, p value<0.001.(Table 2). Moreover, there was a significant *p value* <0.001 between temperatures (Table 2). The results of fecundity by mean value also are shown in Fig.1, length of Graph in temperature of 22°c was longer than 15°and 29°c.

Table 1: The mean value of egg laid and egg hatchability was compared by SPSS software, results are shown, the rate of female fecundity and fertility in temperature of 22°c was more than 15°c and 22°c.

Temperature		Fecundity	Fertility
1.00	Mean	203.2600	85.4000
	N	50	50
	Std. Error of Mean	11.96876	5.46760
2.00	Mean	399.6400	223.7600
	N	50	50
	Std. Error of Mean	11.85004	9.73165
3.00	Mean	85.4000	53.9600
	N	50	50
	Std. Error of Mean	5.46760	2.35675
Total	Mean	229.4333	121.0400
	N	150	150
	Std. Error of Mean	12.12960	7.12604

Table 2: Female fecundity and fertility were compared by ANOVA variation between three temperatures, including, low (15°c), middle (22°c) and high (29°c), there were significant records at level of P< 0.000 between temperature with female fecundity and fertility.

		Sum of Squares	df	Mean Square	F	Sig.
Fecundity	Between Groups	2520047.693	2	1260023.847	241.099	.000
	Within Groups	768245.140	147	5226.157		
	Total	3288292.833	149			
Fertility	Between Groups	816066.720	2	408033.360	188.100	.000
	Within Groups	318877.040	147	2169.232		
	Total	1134943.760	149			

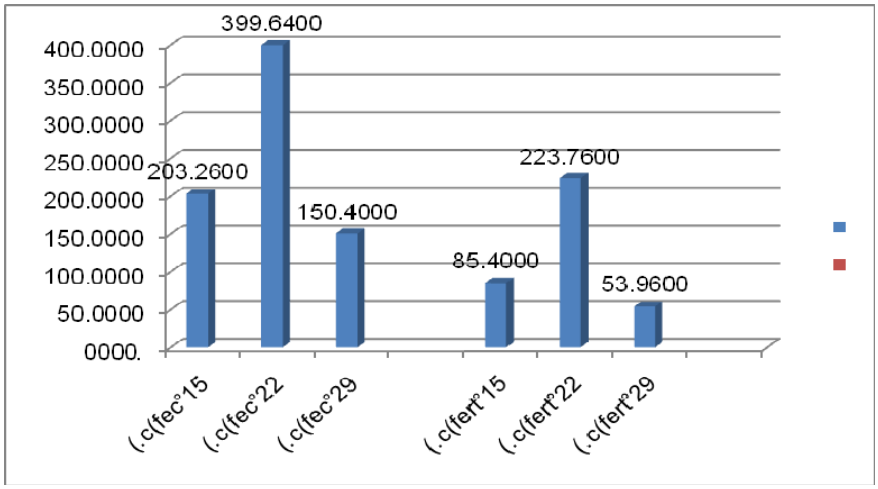

Fig.1: The parameters of fecundity (fec.) and fertility (fert.) from left to right, also, every parameter is three graph that including, low temperature (15°c), middle temperature (22°c), high temperature (29°c). Values are given as means ± SE (N= 50). The length of graphs indicates the variation activity in different temperatures.

The effect of temperature on the fertility: The results of fertility, between temperatures (15°c, 22°c and 29°c), are shown, that mean *p value*<0.000 was significant.(Table 1). These results also were compared by ANOVA variation, the among of produce flies from 22°c, is higher than 15°c and 29°c that a significant *p value* < 0.000 between male age, female age and different temperatures (Table 2). These results also in Fig. 1 show, the length of graph in temperature of 22°c is longer than other temperatures were mentioned.

Regression and Correlation between Parameters: Repeated–measures by regression and correlation for flies revealed a main effect of temperature on the male reproductive performance and female fitness traits. In related to, the results in Table 3 are shown, following the results, there was a Pearson correlation relationship between fecundity, fertility and temperature. In related to Pearson correlation between fecundity and fertility was significant at the 0.795** level, between fecundity and temperature at the 0.325**, between fertility and temperature, at the o.148* level. There was a significant variation, between fecundity and fertility, p value< 0.000. Between fecundity and temperature, pvalue< 0.000, between fertility and temperature, p value< 0.000. (Table 3).

Table 3: Female fecundity and fertility were compared between three temperatures, including, low (15°c), middle (22°c) and high (29°c), there were significant records at level of P< 0.000 between temperature with female fecundity and fertility. In comparison by Pearson correlation also, there were significant records between temperature with fecundity and fertility.** Correlation is significant at the 0.01 level (1-tailed). *. Correlation is significant at the 0.05 level (1-tailed).

		Fecundity	Fertility	Temperature
Fecundity	Pearson Correlation	1	.795**	-.325**
	Sig. (1-tailed)		.000	.000
	N	150	150	150
Fertility	Pearson Correlation	.795**	1	-.148*
	Sig. (1-tailed)	.000		.036
	N	150	150	150
Temperature	Pearson Correlation	-.325**	-.148*	1
	Sig. (1-tailed)	.000	.036	
	N	150	150	150

DISCUSSION

Exposure of high temperature: We have studied regards factors that influence the temperature on the fitness traits and reproductive performance in male and female flies. In related to, we studied the effect of temperature on oviposition had exposure on the three temperatures, means, cold, middle and high temperature, the difference in the mean number of eggs between 15°c, 22°c and 29°c in *Drosophila melanogaster* is significant. These results also are the same with other species of *Drosophila*, including *Drosophila ananassae*, that has been utilized during the present study and has been used for study of effect of temperature on oviposition (McKenzie, 1975; Parsons, 1978; Schnebel& Grossfield, 1986). At low temperature the range of 12-20°c, the among of eggs laid are severely reduced (Mckenzie, 1975; Parsons, 1978). The high temperature, at range of 28°c to 30°c, also among of reduction is more than middle temperature. (David & Clavel, 1969). In our researches, high temperature (29°c) the among of egg laid was very less than middle and also low temperature, also the period of egg laid in low temperature(15°c), is longer than middle and high temperature. Also among of egg laid in daily, low temperature is less than middle and

high temperature, in opposite of that, high temperature period of egg laid is shorter than middle and low temperature, also the results of longevity in females, low temperature longer than middle and high temperature, in females that exposure of high temperature earlier were dead. These suggests that temperature-dependent oviposition is an important factor affecting egg laid in *Drosophila*, because of limited physiological capabilities of the organism at low temperature.

Fertility element: Fertility element, including effect of male-female age and temperature on the hatchability, viability, reproductive capacity. In *Drosophila melanogaster*, population, normal temperature, is necessary for developmental and physiological processes. (Feder *et al*., 1996; Kamping & Van Delden, 1999). Also, Kamping 1999, found, the flies that exposure of high temperature stress, (around 33°c), highest mortalities and strongest karyotypic effects when the preceding of larval development occurred at 33°c, because of limited physiological capabilities of the organism at a low temperature.(Kamping, 1999). In our studies, the among of egg hatchability, as compared in temperature of 29°c was less than 22°c and 15°c. Results are shown however between male and female with temperature was significant, but also, in Figure 1, from temperature of 22°c to 29°the length of graph longer than from temperature of 15°c to 22°c. So, the female flies had adapted when at exposure of cold temperature (15°c) than hot temperature (29°c). And in middle temperature is best for getting higher offspring in *Drosophila mekanogaster*.

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