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Yeşim Koç
Sinop University, Education Faculty, Science Education Department, Sinop, Turkey

Correspondence
Yeşim Koç
Sinop University, Education Faculty, Science Education Department, Sinop, Turkey

Effect of different temperature on preadult developmental time and fecundity of *Drosophila melanogaster* Meigen, 1830 (Dıptera:Drosophiladae)

Yeşim Koç

Abstract
This study was carried out to determine the effect of temperature on the preadult developmental time and fecundity of *Drosophila melanogaster* at 20, 23, 26 and 32 °C. Studies were carried out under the laboratory conditions at twelve hours dark,twelve hours light photoperiod regime and % 60 ± 5 relative humidity with four temperature (20, 23, 26 and 32 °C). The composition of the food type (named as solid food) consisted of water 74.2 cc., molases 13.5 gr., corn flour 10 gr and propiyonic acid (0.7 cc). Preadult developmental time and female fecundity for each trial was determined. Fecundity was highest when reared at 26 °C. Total preadult developmental time at 20,23,26 and 32 °C was 19,16,10and 13 days, respectively. Developmental time was highest reared at 20 °C. Results from this study are show that changing the temperature is important. *Drosophila* is a widely used and well suited model system for studying genetics and biology. Therefore, we initiated a study to quantify the effects of temperatures on developmental time and fecundity of *D. melanogaster*.

Keywords: *Drosophila melanogaster*, development, temperature, fecundity, preadult developmental time

1. Introduction
Insects are poikilothermic animals that are largely affected by various environmental factors. Among all the climatic factors, temperature has probably the greatest effect on insect development and biology. (Taylor 1981; Pedigo 1989; Wigglesworth, 1974; Gilbert and Raworts, 1996; Dell at all., 2011) [27, 20, 8, 5]. Previous studies have shown that temperature influences various biological characteristics of insects such as sex-ratio, adult life-span,reproduction, survival, fecundity,larval stages, intrinsic rate of increase of insect populations and fertility (Yang *et al.* 1994; Dreyer and Baumagartner 1996; Infante 2000, Chi and Su 2006) [30, 7, 13, 3]

The effects of temperature on insect development may vary among species, but lower temperatures typically result in a decrease in the rate of development and increase in the duration of the time spent in each developmental stage (Petersen *et al*., 2000; Levesgue *et al*., 2002) [21, 16].

Due to the exothermic nature of insects, metabolic rate is extremely dependent upon environmental temperature. Optimal growth and development of insects falls within a fairly broad range of temperatures. (Rock and Shaffer, 1983) [24]. Special set of effects of temperature on development is connected with developmental arrest. The state of easily reversible, temperature-dependent developmental arrest is known as quiescence. It is typical of insects adapted to relatively short periods of unfavorable, nonlethal circumstances. Insects that will be exposed to harsh conditions lasting for many months enter a programmed developmental arrest, diapause

D. melanogaster is a homometabolus insect, as characterized by the fact that its larval stage and adult stage are separated by a distinct pupae stage where metamorphosis occurs. Larva develop through 3 distinct stages, or instars, each larger than the last; at the end of its third instar, the larva crawls from its food medium and pupates (Random 1982) [22]. Previous studies on temperature-dependant development for *D. melanogaster* suggest a positive relationship between temperature and development (Partridge *et al.* 1994, AL-Saffar *et al.* 1995) [19, 2]. AL-Saffar *et al*. found that development time steadily declined for *D. melanogaster* as temperature was raised from 15 °C to 30 °C (1995). We examined the effect of the four different temperature. *Drosophila* is a widely used and well suited model system for studying genetics and biology.

Therefore, we initiated a study to quantify the effects of temperatures on developmental time and fecundity of *D. melanogaster*.

2. Materials and methods

This study was carried out to determine the effect of temperature on the preadult developmental time and fecundity of *Drosophila melanogaster* at 20, 23, 26 and 32 °C. Studies were carried out under the laboratory conditions at twelve hours dark,twelve hours light photoperiod regime and % 60 ± 5 relative humidity with four temperature (20, 23, 26 and 32 °C). The composition of the food type (named as solid food) consisted of water 74.2 cc., molases 13.5 gr., corn flour 10 gr and propiyonik acid (0.7 cc). (Alemdar,1980) [1]. Insects were placed in glass jars appropriately prepared in nutrient hi During the larval period of insects, folded pieces of papers were put into the jars so that they could easily reach the pup phase. In the trials, firstly, on the same day matured insects were separated. The same numbers of adult female and male individuals were put in separate jars. All jars were preserved for the proper different temperature. As the pups were observed, all mature insects were separated regarding their sex and their numbers were identified. For each trial in certain circumstances, the number adult has been identified. At least three generations produced insects were used for the certain temperature.

Flies were maintained in half-pint bottles of generations on a 12:12 h light:dark cycle at 20,23,26 and 32 °C and % 60 ± 5 relative humidity on a standard nutrition. Flies of the parental generation were raised on a standard diet. Subsequently, 2female and 2 males were transferred into bottless. The eggs were allowed to hatch, and developed at different temperature until they reached adult. Developmental times and adult number were measured as larva-to-pupa, larva-to-adult, and pupa-to-adult in every experiment, fecundity determined of female from each experiment, initially out of two incect is used, because it was divided into two parts. The prepared containers were kept at the temperatures specified. As the number of adults in the bottles was determined. A specific temperature environment, for each experiment number of adults were found.

3. Results

Our results showed that at 20 °C, the developmental time of *D. melagogaster* individuals was relatively longer than those reared at other temperature. The average developmental time at 26 C was 10.33 days, whereas it was 19.66 days at 20 °C The highest fecundity for *D. melanogaster* was found at 26 °C (table 1, figüre 1). As shown in Table 1 and Figure 1, preadult developmental time was much longer at 20 °C than that of 23,26 and 32 °C. These differences were statistically significant (P<0.05). As shown in table 1, in general, as the temperature increases fecundity of adult increases. But As shown in table 1, fecundity was observed most at 26 °C as compared with all conditions. Significant differences were found in sometemperature, especially for 20 °C and 26 °C.

Table 1: Effect of Different Temperature on Preadult Developmental Time and Fecundity of *Drosophila melanogaster*

Temperature	Preadult developmental time Ort±S.H.	Fecundity Ort±S.H.
20 °C	19.66±0.88 a	18.33±1.20 a
23 °C	16.00±0.57 b	41.00±1.15 b
26 °C	10.33±0.33 c	88.00±1.15 c
32 °C	13.33±0.33 d	70.33±1.20 d

Difference between the averages shown at the same column with lowercase is negligible. p>0.05 SH:Standard error Average of 3 repeated of processes each with 40 beings

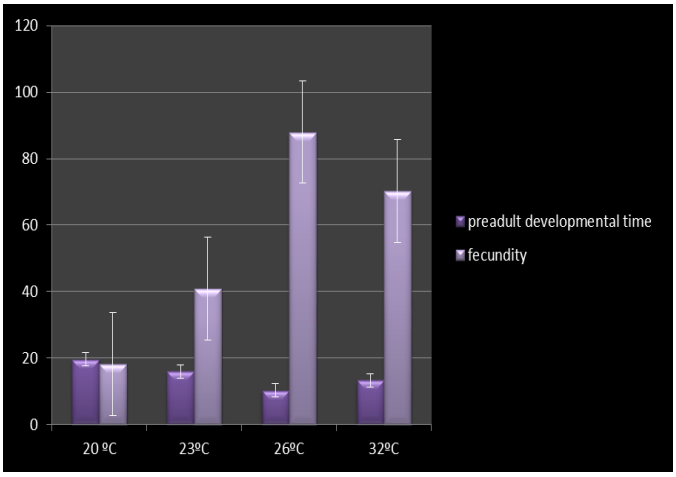

Fig 1: Effect of Different Temperature on Preadult Developmental Time and Fecundity of *Drosophila melanogaster*

Statistical analyses: SPSS 15.0 package program was used for the statistical assessment of the data. The differences between the groups were compared with One-way ANOVA, using SPSS 15.0. Tukey HSD Test was used to determine the differences between the means

4. Dissussion and conclusion

Temperature is one of the most important abiotic factors affecting the rates of development time, reproduction, life span, survivor, larval and pup stages, fecundity (Rollo and Gunderman 1984; Dell at all., 2011) [25, 5]. This is because each of these physiological processes requires energy obtained from temperature-dependent chemical reactions that are restricted by lower and upper thresholds (Wang and Tsai, 2000) [32].

Our results showed that at 20 °C, the developmental time of *D. melagogaster* individuals was relatively longer than those reared at other temperature. The average developmental time at 26 C was 10.33 days, whereas it was 19.66 days at 20 C. The highest fecundity for *D. melanogaster* was found at 26 °C.

Similar results were reported for other insect species. Whitman stated that Taeniopoda eques (Orthoptera: Acrididae), from the first stage nymphal period to the adult stage, required 60 and 35 days at 25 °C and 30 °C, respectively. Genotype-by-environmental interactions can also maintain quantitative genetic variation in heterogeneous environments (Mackay 2002) [17]. Furthermore, environmental temperature dramatically affects both developmental time and fecundity in *Drosophila* (Vieira *et al.* 2000; Klepsatel *et al.* 2013) [29, 15].

Similarly, Woodson and Edolson observed that Listronotus texanus (Coleoptera: Curculionidae), from egg to adult,

needed about 65 and 30 days at 20 °C and 27.5 °C, respectively. Kimura (2004) [14] studied the geographical differences between populations of Drosophila species obtained from different parts of Japan and revealed that the 50 % lethal temperature for adult D. suzukii was 32.2–32.7 _C in strains from both Sapporo (43.1_N) and Tokyo (35.5_N). Similar results have shown of *Alphitobius diaperinus*, where their fecundity was significantly highest in LD regime and lowest in LL photoperiodic regime (Razzak *et al.*, 2012) [23]. Fecundity of Oryzaephilus mercator was highest in the LD regime followed by LL and this difference was not significant (Okiwelu *et al*., 1998) [28].

Pre-adult development of insects and the degrees of temperature they need to carry on their adult lives can vary depending on species. This is one of the most important adaptations they have in order to be able to survive under varying climatic conditions. As in other living beings, extremely low or extremely high temperatures cause important physiological reactions in insects. (Hill *et al.*, 1968; Levesgue *et al*., 2002) [10, 16].

As in many insects, in *Drosophila* temperature is raised above a certain value, as is a gradual decrease fecundity of *Drosophila* (David and Clavel, 1969; Siddiqui and Barlow, 1972; McKenzie, 1975; Huey *et al*., 1995; Gilchristi and Huey, 2001; Hoffmann *et al*., 2003; Dillon *et al.*, 2007) [4, 26, 18, 12, 9, 11, 6]. Fecundity was highest when reared at 26 °C in this sduy. Total preadult developmental time at 20,23,26 and 32 °C was 19,16,10 and 13 days, respectively. Developmental time was highest reared at 20 °C. Results from this study are show that changing the temperature is important. *Drosophila* is a widely used and well suited model system for studying genetics and biology. Therefore, we initiated a study to quantify the effects of temperatures on developmental time and fecundity of *D. melanogaster*. Preadult developmental time and fecundity were both affected by temperature (table1,figure 1). Thus, developmental time and fecundity were suppressed temperature at all stages of the *D. melanogaster* life cycle.

In conclusion, temperature significantly affected the total developmental time and fecundity in *D. melanogaster*. From the obtained results it can be understood that for the upbringing and production of *D. melanogaster*, one must pay attention different temperature condition

5. References

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