The Consistency of Sex Ratio of *Drosophila melanogaster* (Meigen) in Different Physical Environment Condition

Ahmad Fauzi*;, Shefa Dwijayanti Ramadani***, Ika Sukmawati ****
*Al Ya'lu Middle School
** Departement of Biology Education, Universitas Muhammadiyah Malang
***Departement of Biology Education, Universitas Islam Madura
**** Departement of Biology Education, Universitas Negeri Malang

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ABSTRACT

Several environmental factors have been reported affect sex ratio in many organisms. The environmental factors that affecting sex ratio could from physical, chemical, or biological factors. In this study, the effect of some physical factors on sex ratio in *D. melanogaster* were studied. In normal laboratory condition, high temperature, dark condition, and EMF exposure, the sex ratio were 0.91:1.09, 1.00:1.00, 0.89:1.11, and 1.01:0.99 respectively. From the result, it can be seen that males and females adult filial number ratios in each group were close to 1:1.

Corresponding Author:

Ahmad Fauzi,
Al Ya'lu Middle School
Jl. Teluk Mandar No. 55 Arjosari, Malang, East Java, indonesia, 65126
Email: fauizou91@gmail.com

1. INTRODUCTION

Sex ratio is a topic often discussed in various biological studies. Sex ratio itself is a term that generally refers to the ratio of males to females in a population [1,2]. The ratio is commonly expressed as the number of males per 100 or 1000 females or the fraction of the total population that is female (or male) [1,3,5]. The proportion of females in the ratio indicate the reproductiove potential of a population [4]. Moreover, sex ratio also reflects a number of life history traits, such as the importance of sexual mating system and also the other information related to the past, present, and future of a population [1,4].

In many organism with the sexes are separate, females are produced in approximately equal numbers with males [6]. Therefore, in many organism, such as insects, the sex ratio is 1:1 [5]. This ratio maximizes the availability of males to females, and hence maximizes genetic heterogeneity [4]. In the absence of manipulation, the sex ratio are constant [7]. However, several environmental factors ultimately affect sex ratios [4,6,8]. The environmental factors affecting sex ratio can from physical, chemical, or biological factors [1,4,6,8,9].

In this study, the effect of some physical factor on sex ration in *D. melanogaster* were studied. Those physical factor are environmental temperature, minimum light condition, and electromagnetic field (EMF) radiation. Temperature is one of the major factor regulating population growth [10,11]. This factor is one of the most important parameters affecting the live of organisms [12]. Beside temperature, light can also be a limiting factor [10,13]. Light can affect the reproductive of organisms [14]. On the other hand, recently, EMF field radiation have also been reported have the poteintal in affecting the population of organisms [15].

D. melanogaster was used as a model organism in this study. The organism was choosen in this study because of some reasons. First, Drosophila is an organism that produced consistently high numbers of offspring [16]. Second, this organism is recorded as rapid breeder with a lot of eggs and short life cycle [16-18]. Third, this organism has often been as model organism in many study examining various problems in biology [16,17].

2. RESEARCH METHOD

2.1. The organsim and environmental conditions

D. melanogaster wild-type strain from Genetic Laboratory FMIPA UM were used in this study. Flies were cultured in a 200 ml cylindrical glass bottle, with 7 cm diamater and 9 cm height, filled with 30 ml standard food, as described in Fauzi et al [15]. The flies cultures were kept in a research room at Genetic Laboratory FMIPA UM. When there were blackened pupae, the pupae were isolated into plastic tube with 1 cm diameter and 5 cm height. Adult flies that emerge from this plastic tube were using for crossbreeding at treatment stage.

2.2. Treatment stage

D. melanogaster ♂ wild-type strain was crossed with ♀ wild-type strain in glass bottle that the same with cultured bottle, both of it 2 X 24 hours after hatching from pupae. For temperature treatment, a pair of three replicates of *D. melanogaster* crossbred were exposed continuously to a constant temperature of 30° C in an incubator. For minimum light treatment, a pair of three replicates of *D. melanogaster* crossbred were placed in a sealed opaque box. The Crossbreeding box was then coated with black plastic and placed in a room that was not much exposed to light. For EMF exposure treatment, a pair of three replicates of *D. melanogaster* crossbred were placed close to GSM mobile phone with provider that using frequencies at 900/1800 MHz (3G) and HSDPA 2100 (4G) as a source of exposure source. Along with treatment groups, the normal laboratory room condition group was also set up. The group was placed in room with temperatures fluctuating naturally following the condition of the surrounding temperature (25-30° C), wiht normal light conditions (light-dark change/LD 12:12h), and was not exposed by mobile phone.

2.3. Data collection

The number of adult filial males and females at each group were recorded. Then, the data were calculated to get ratio of males to females.

3. RESULTS AND ANALYSIS

Fig. 1 is the graphs show the comparison between male and female adult filial number of *D. melanogaster* whereas Table 1. show the sex ratio at each different environmental condition. Based on Fig. 1 and Table 1, it can be seen that the comparison between males and females in each group were close to 1:1. The present results indicate sex ratio in *D. melanogaster* was stable on various environmental condition that have been designed in this study.

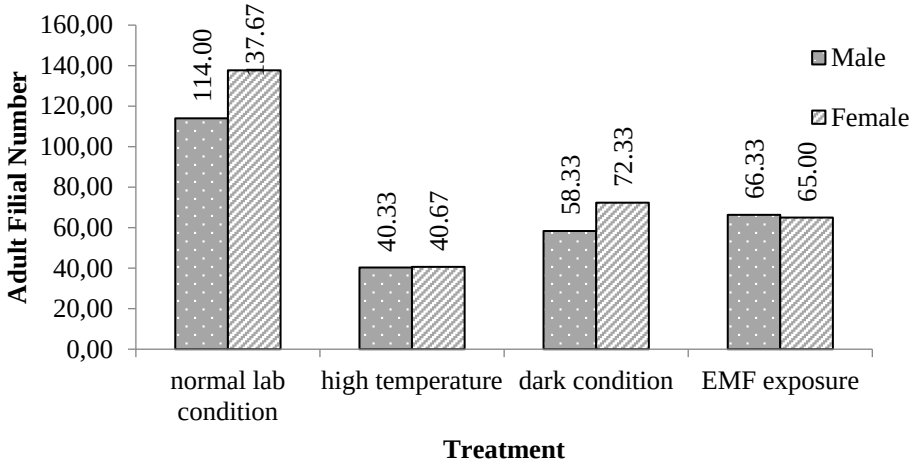

Figure 1. The comparison between male and female adult filial numberof *D. melanogaster* at different environmental condition

The determination of sex in Drosophila is not only based on the existence of Y chromosome in it body. [19]. The determination of sex in this organism is more determined by the ratio of X chromosome number with the number of sets of autosomes [20]. This is due to the fact that the X chromosomes and autosomes together play a critical role in sex determination in Drosophila [19]. However, the determination of sex like that make the sex ratio Drosophila in normal condition still close to 1:1. But, the sex that determined by its genetic makeup or chromosomes in their body more refers to sex at embrio. After birth, or indeed before that, flies will growth and

develop until flies enter the adult phase, during the process some factor from environment will affect and control the growth of the population of the organism [10,11].

Table 1. Sex Ratio of *D. melanogaster* at Each Different Environmental Condition

Group	Sex Ratio
Normal laboratory condition	0.91:1.09
High temperature	1.00:1.00
Dark condition	0.89:1.11
EMF exposure	1.01:0.99

Temperature is one of environmental factor that can influence sex determination in adult phase [19,20]. The temperatures can affect the survival level of males or females from larval phases until imago phases in such a way as to shift the sex ratio [19]. Furthermore, it has been known there are several gene in Drosophila that involve determining sex could be affected by temperature [21]. However, based on Fig. 1 and Table 1. in high temperature treatment, the sex ratio was still 1:1. The present result was also not agreement with previous researchs that reported temperature is one of environmental factor that can affect sex ratio in Drosophila [22]. But, the present result was in line with the other previous research reported there were no statistical support for an effect of temperature on the number of males and females reaching the adult stage [23]. Therefore, because of the sex ratio in Drosophila at embrio stage is 1:1 and there were no gender related effect of temperature during the organism growth until adult phase, the sex ratio in adult phase still 1:1.

In dark condition treatment, the sex ratio was 0.89:1.11. The ratio was still close to 1:1, but in this study, this ratio is the most deviates from 1:1. Until now, no reports have reported any effect of light on the sex ratio. Differences in the number of males and females in dark condition treatment in this study indicate there are gender related effect of light during the organism reach adult phase. Light is used by organisms as the external signal controlling circadian rhythms that regulating gene expression and physiological processes in their body [24-26]. Therefore, the The differences in the number of males and females indicate a different degree of influence of light on circadian rhythms in both sexes.

In EMF exposure treatment, the sex ratio was 1.01:0.99. The ratio was very close to 1:1. This result was an agreement with previous study reported EMF may not exert a gender-related influence on flies [27]. Related to that, Moorhouse & Macdonald stated sex ratio variation is commonly observed as a consequence of varying survival and value of offspring of different sexes [28]. From the present result and the statement, it can bee seen that, the radiosensitivity of male flies to EMF has the same level with female flies [27].

4. CONCLUSION

The effect of some physical factor on sex ration in *D. melanogaster* were conducted in the present study. In normal laboratory condition, high temperature, dark condition, and EMF exposure, the sex ratio were 0.91:1.09, 1.00:1.00, 0.89:1.11, and 1.01:0.99 respectively. From the result, it can be seen that the comparison between males and females in each group were close to 1:1. The results indicate sex ratio in *D. melanogaster* was stable on various environmental condition that have been designed in this study.

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