



The Effect of Mass Gainer on The Rate of Development and Percentage of Hatchability in *Drosophila melanogaster*

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Abstract

Drosophila melanogaster, has been a significant model organism in embryonic development research. Egg to adult rate of development and hatchability or viability are the important preadult parameter of fitness in *D. melanogaster*. Different diets can alter the nutritional intake of the flies, affecting their overall health and consequently the viability of their offspring. *D. melanogaster* flies were reared on wheat cream agar, 10g mass gainer, and 20g mass gainer media. This experiment was set up to determine the effect of mass gainer on the rate of development and % of hatchability from larva to pupa and pupa to adult in *D. melanogaster*. The outcome in this study showed that rate of development and % of hatchability in larva to pupa and pupa to adult was significantly greater in the 20g of mass gainer media, average in 10g mass gainer media and the least in wheat cream agar media. Thus the mass gainer is an effective supplement which is rich in protein and carbohydrates may promote higher hatchability rates compared to diets deficient in essential nutrients. Hence, the mass gainer diet influences the greater development and % of hatchability from larva to pupa and pupa to adult stage in *D. melanogaster*.

Keywords: Hatchability, rate of development, larva, pupa, adult, *D. melanogaster*.

Introduction

The term rate of development refers to the process of somatic maintenance, growth, development and reproduction. Hatchability in *D. melanogaster* refers to the proportion of viable offspring that hatch from eggs laid by adult flies.

Nutritional enhancements in the diet are known to enhance fitness (Djawdan *et al*, 1998). They also showed that the increased egg to adult viability in media rich in sucrose along with the positive effects of protein enrichment on the female survival. Thus, indicating that nutrition at the pre-adult stages plays a major role in the overall fitness of the adult. The different levels of food available at these stages also cause the regulation of the resource processing. In addition to this they showed that lower levels of food leads to lower body size (Zoltan and Gerdien, 2003), which is a general phenomenon in ectotherms (Atkinson and Sibly, 1997) and is shown in *Drosophila melanogaster* and other species (Gebhardt and Stearns, 1998).

Various factors, including temperature, humidity, and genetic mutations, can influence hatchability rates in *D. melanogaster*. The rate of development, along with pre-adult fitness is known to be highly correlated, while the rate of development (time from egg laying to eclosion) is considered as a major component of the pre-adult fitness of an organism. The pre-adult viability is measured by the survival through the preadult stages. Therefore, a study of developmental rate also gives information about viability (Bonnier *et al*, 1959). Both internal and extrinsic factors that are known to influence all biochemical, physiological, and developmental changes that occur in an organism have an impact on the overall growth, development, and reproduction of an organism. (Sterner and Schulz, 1998; Taylor *et al*, 2005).

In earlier studies on species of *Drosophila* (Geeth and Krishna, 2015) proved that the organic fruits chikku and watermelon had significant influence on preadult fitness. The avocado and yogurt had showed a positive effect on larva to pupa, pupal to adult viability and rate of development in *D. melanogaster* but their study did not had preadult development benefits on *D. melanogaster* (Alexander and krishna, 2018). Further Alwyn's D Sowza and Krishna (2015) who while studying in *D. melanogaster* have also found that the consumption of alternative natural energy drink was beneficial in preadult development.

Mass gainer is a dietary supplement available in powdered form used to help gain weight which is loaded with calories through carbohydrates and proteins with varying amount of fats, vitamins, minerals, amino acids, and other nutrients. However, there is no work conducted on the effect of mass gainer on the rate of development and % of hatchability in *Drosophila*. Therefore, this experiment has been undertaken.

Materials and Methods

The mass gainer was purchased through Flipkart App from A207, Lane No. 9, No. 4, Mahipalpur, Delhi, 110037, India. This mass gainer used to prepare the experimental media.

Establishment of stock

Experimental Oregon K strain of *D. melanogaster* used in the study was collected from *Drosophila* stock center. Department of studies in Zoology, University of Mysore, Mysore and this stock was cultured in bottles containing wheat cream agar media [100g of jaggery 100g of wheat cream rava, 10g of agar was boiled in 1000 ml distilled water and 7.5 ml of propionic acid was added]. Flies were maintained in laboratory conditions such as humidity of 70% and 12 hours dark 12 hours light cycles and temperature $22^{\circ}\text{C} \pm 1^{\circ}\text{C}$.

The flies obtained as above were used to establish the experimental stock with different diet media [Wheat cream agar media: Wheat cream agar media was prepared from 100g of jaggery, 100g of wheat cream rava powder, 10g of agar boiled in 1000ml distilled water and 7.5 ml of propionic acid added to it.

10g of mass gainer media: is prepared from 100g of jaggery, 90g of wheat cream rava and 10g of mass gainer powder, 10g of agar boiled in 1000ml of distilled water and 7.5 ml of propionic acid added to it

20g of Mass gainer media: is prepared from 100g of jaggery, 80 g of wheat cream rava, 20g of mass gainer powder, 10g of agar boiled in 1000ml of distilled water and 7.5 ml of propionic acid added to it.]. The flies emerged from the wheat cream agar media and other experimental treated media were maintained under the same laboratory conditions as mentioned. These flies were used to study the rate of development and % of hatchability from larva to pupa, pupa to adult.

Experimental procedure

To determine the influence of mass gainer on the rate of development approximately 20 flies, 10 male and 10 female flies grown in control media were collected. The gathered flies were placed into culture bottles of control, 10g mass gainer and 20g mass gainer and left for 3 hours. Later, the flies were removed from culture bottles and it was left for 24 hours, to produce 1st instar larvae from the egg.

For Rate of Development:-Thirty 1st instar larvae were retrieved by scooping the media from the culture bottles. The collected 1st instar larvae were introduced in the vials containing their respective media- control, 10g and 20g mass gainer. Then these larvae were observed till they form pupa and the time was noted exactly when they form pupa and it was further observed till the flies emerges from the pupa and time consumed for fly emergence from pupa is noted.

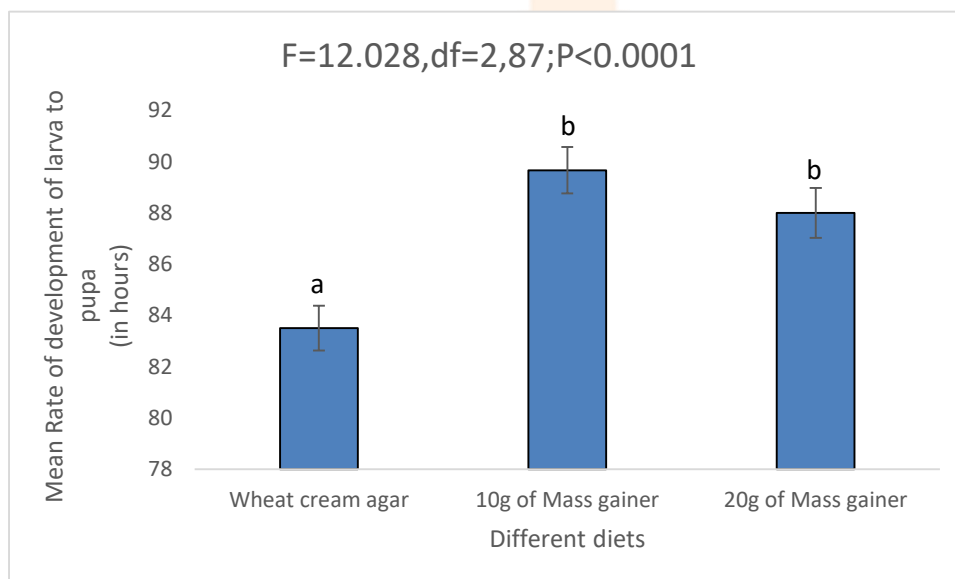
For percentage of Hatchability :-Thirty 1st instar larvae were retrieved by scooping the media from the culture bottles. The collected 1st instar larvae were introduced in the vials containing their respective media- control, 10g and 20g mass gainer. Then these larvae were observed till they form pupa and total number of pupae formed were noted. Further, the total number of pupa hatched to form flies were noted.

Results and Discussion:

Effect on rate of development of *Drosophila melanogaster* from larvae to pupa:

Diet is a major environmental component that influences an organism's growth, development, reproduction, and survival. The quality and quantity of nutrients available vary between diets. As a result, the current study sought to evaluate the positive and negative effects of Mass Gainer on the preadult development of *D. melanogaster*. Figure 1: illustrates the mean $\pm$ standard error of fly development rates from 1st instar larva to pupa on wheat cream agar and mass gainer supplemented medium. When compared to flies fed with control media, the data obtained indicated that flies grown in 10g mass gainer media and 20g mass gainer media developed at a significantly faster rate of development. In contrast, it was discovered that flies grown in control media developed at a slower rate of development. Previous studies also reveal (Shreejani *et al*, 2023) that the spirulina and oyster mushrooms (Harshitha and Krishna, 2023) provides greater quantity of nutrients and energy required for the preadult development of larva to pupa and pupa to adult stage, whereas the control media do not equally support energy and required nutrients to increase the preadult fitness. Our tests revealed that flies fed on a 10g mass gainer media and 20 g of mass gainer diet had much higher larvae to pupae viability compared to those fed on control media. This implies that, the 10g mass gainer media and 20g of mass gainer media gives more nutrients and energy for faster development from larva to pupa but the control media does not adequately sustain preadult fitness.

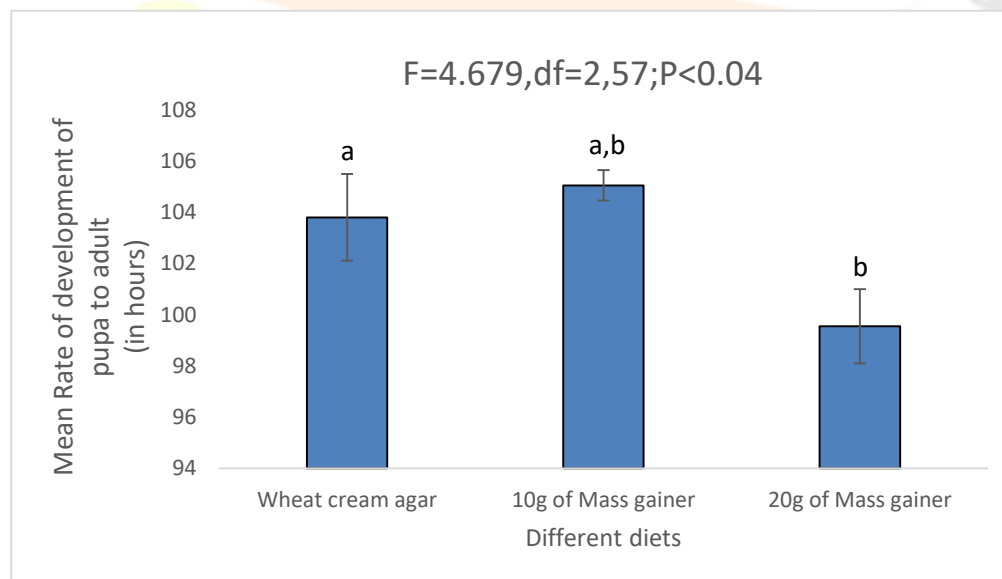
Figure 1: The effect of different concentration of mass gainer diet on the rate of development from larva to pupa of *D. melanogaster*. [Control diet- wheat cream agar media; mass gainer diet (10g, 20g concentration)].



Effect on rate of development of *Drosophila melanogaster* from pupa to adult:

Figure 2: illustrates the mean $\pm$ standard error of fly development rates from pupa to adult on wheat cream agar and mass gainer supplemented medium. When compared to flies fed with control media, the data obtained indicated that flies grown in 10g mass gainer media and 20 g mass gainer media developed at a much faster rate of development. In contrast, it was discovered that flies grown in 20g mass gainer media developed at a slower rate of development. In our experiment, both control and 10g mass gainer and 20g mass gainer media flies were cultured under identical lab conditions, despite the simple change being in the nutrient composition of the diet. Hence, the variance in the rate of development was not related to the difference in temperature. Our study found that nutrient-rich mass gainer supplement media has a higher nutrient content, leading to increased growth and reproductive rates. Furthermore, it improves pre-adult fitness in *D. melanogaster*. In *Drosophila*, the larva is the feeding stage of the pre-adult stages of development. As a result, the observed results indicate that the quality, amount, and distribution of nutrients in the mass gainer supplemented meal were more effective in promoting the rate of development from pupa to adult than the control diet.

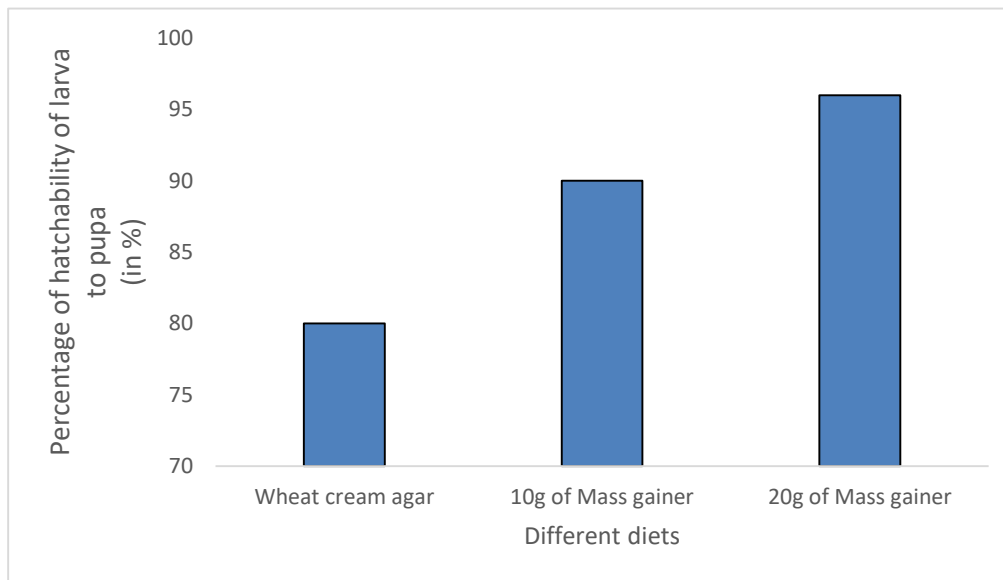
Figure 2: The effect of different concentration of mass gainer diet on the rate of development from pupa to adult of *D. melanogaster*. [Control diet- wheat cream agar media; Mass gainer diet (10g, 20g concentration)]



Effect of mass gainer on the percentage of hatchability from larvae to pupa and pupa to fly in *D. melanogaster*.

The % of hatchability in *D. melanogaster* flies raised with wheat cream agar, 10g of mass gainer and 20g of mass gainer media are provided in the figure 3. According to data it was noticed that % of hatchability from larva to pupa was greater in the 20g and 10gm of mass gainer media compared to the wheat cream agar media which showed the least % of hatchability.

Figure 3: The effect of different concentration of mass gainer diet on percentage of larva to pupa hatchability of *D. melanogaster*. [Control diet - wheat cream agar media; 20gm mass gainer, 10g mass gainer concentration)].

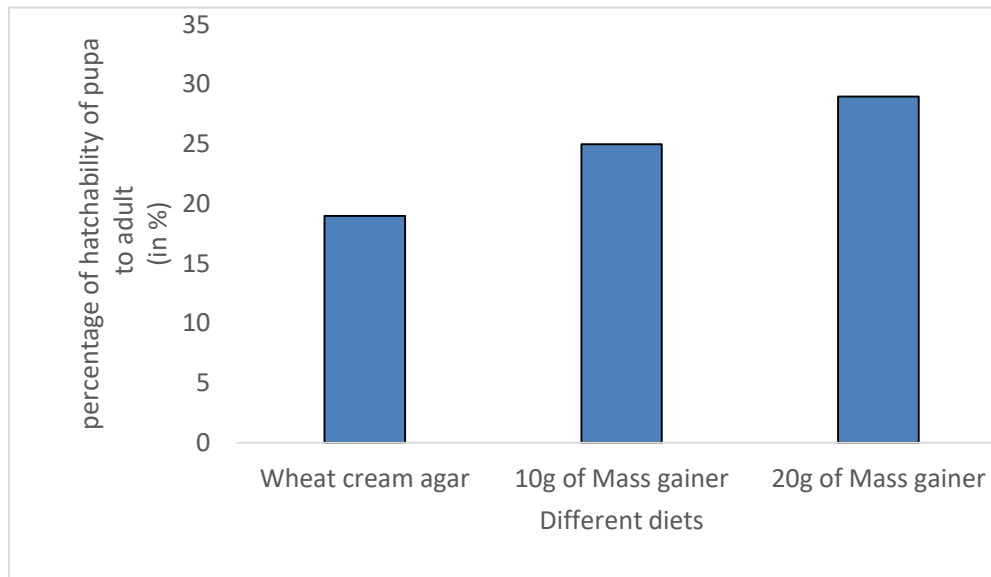


Hatchability also known as viability, egg to larval, larvae to pupae, pupae to adult viability are some of the phases that comprises preadult viability. Viability is impacted by both chemical parameters such as pH and physical factors like light, temperature, moisture and so on. With temperature increases, the rate of *Drosophila* development tends to slow down. (Al-Saffar *et al*, 1995; Gilbert and De Jong, 2001; Hartwell *et al*, 2011). In our study, the result obtained (figure 3 and 4) shows that the percentage of hatchability from larvae to pupa was greater in flies fed with 20g and 10g mass gainer media whereas lower percentage of hatchability in flies fed with wheat cream agar media. This cannotes that mass gainer diet exert influence in *D.melanogaster* by providing essential nutrients which is necessary for hatchability from larvae to pupae stage. While in contrary, the wheat cream agar media do not equally supported the required nutrients to enhance the hatchability percentage in *D.melanogaster*.

Effect of mass gainer on the percentage of hatchability from pupa to adult in *D. melanogaster*.

The % of hatchability in *D. melanogaster* flies raised with wheat cream agar, 10g of mass gainer and 20g of mass gainer media are provided in the figure 4. According to data it was noticed that % of hatchability from pupa to adult was greater in the 20g and 10gm of mass gainer media compared to the wheat cream agar media which showed the least % of hatchability

Figure 4: The effect of different concentration of mass gainer diet on percentage of pupa to adult hatchability of *D. melanogaster*. [Control diet - wheat cream agar media; 20gm mass gainer, 10g mass gainer concentration)].



Previous studies have shown that nutrient-poor diets can cause smaller sized adults (Vijendravarma *et al.*, 2010). Various diets were also used in recent studies to analyze the fitness of pre-adult *D. melanogaster*. The impact of organic fruits and vegetables on the fitness of pre-adult individuals was demonstrated by (Chabra *et al*, 2013). It was discovered that flies that were given organic fruits experienced a noticeably higher level of pre-adult development speed. Hatchability or viability increases with increased rate of development. In the view of the fact that flies were cultured in control and mass gainer media under the same laboratory conditions the only difference was the nutrient available in the diet. Thereupon, we can culminate that a mass gainer diet uplifts the percentage of hatchability in *Drosophila melanogaster*.

Conclusion

In our studies we found that flies fed with 10g mass gainer and 20g mass gainer had high greater rate of development compared to the wheat cream agar media and also flies fed with 10g mass gainer and 20g mass gainer had high % of hatchability than wheat cream agar media. Thus mass gainer increases rate of development and % of hatchability in *D. melanogaster*.

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